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Electrical World

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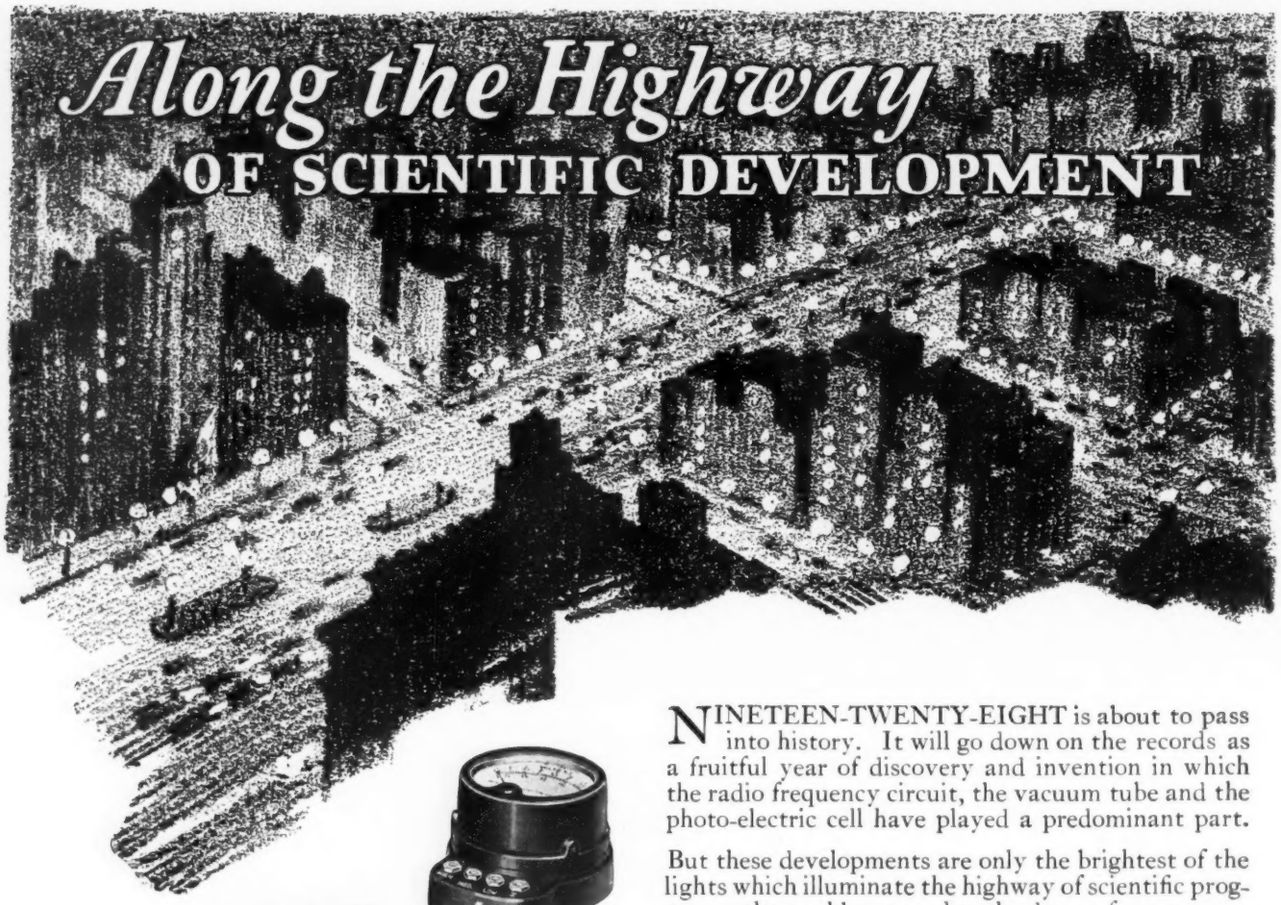

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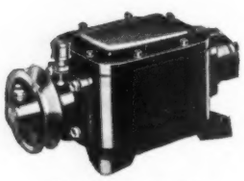

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NINETEEN-TWENTY-EIGHT is about to pass into history. It will go down on the records as a fruitful year of discovery and invention in which the radio frequency circuit, the vacuum tube and the photo-electric cell have played a predominant part.

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Electrical World

The consolidation of Electrical World, Electrical Engineer and American Electrician

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QUALITY EQUIPMENT ASSURES PERFORMANCE

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The lessons of the past clearly show that there is a Quality needed in cables and other plant equipment that cannot be written into specifications. No standardization of materials, or of technique in manufacture, has yet been reached where all *similar* products can safely be placed upon a plane of equal value.

With even greater construction projects and more exacting operating conditions coming along, assured Performance of plant is most vital. To this end, there remains the important objective of securing materials which not only satisfy engineering design, but whose excellence of quality leaves a comfortable margin for operating contingencies.

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Electrical World

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Volume 92 — *New York, Saturday, December 29, 1928* — Number 26

The Christmas Gift to California

WITH the signing of the modified Swing-Johnson bill by President Coolidge last week, that mammoth project on the Colorado River at Black Canyon draws nearer a reality. Arizona and some of the other states involved may object and for a time block the whole scheme, but with the hardest part of the battle already won, it is unlikely that opposing states cannot be brought into line. Thus the country, out of the goodness of its heart and not because of the economic merits of the project, makes to California a magnificent Christmas gift.

It is futile to say that the dam and its appurtenances, huge as the project is, cannot be built, because that would be an aspersion on the entire engineering profession. That it will cost more than estimated matters not now, for the nation must keep faith after having sanctioned construction. The government has made possible that which private enterprise would not undertake. The benefits all go to California, which will profit not only after the dam and all its auxiliary works are completed, but just as soon as construction begins; for most of the millions of dollars the project will cost will benefit the business men in California. Thus that great state had reason to wish all its sister states a very merry Christmas.

* * * *

Inconclusive Evidence

IN THIS issue of the Electrical World is printed an abstract of a report on system costs that was presented at the convention of the National Association of Railroad and Utilities Commissioners held recently at New Orleans. The report was intended to contain the concrete results of a cost study of representative large and small power systems, but it fell short of the mark. The data are too meager to permit of generalized conclusions.

The purpose of the committee that prepared the report was to study comparative costs in large and small electricity supply systems and to ascertain by quantitative analysis how much virtue there is in the generally accepted idea that the large system operates more economically than the smaller. If the ambitious original plan of the committee to obtain data from thirty-six representative systems in nine different states had been accomplished, the conclusions not claimed but indicated in the report might have some weight.

In view of the very slender foundation piers of data on which the structure of argument in the report is built, one cannot but say that the edifice of reasoning therein is worse than insecure, it is actually dangerous. In the nation there are men in positions of influence who for good or bad reasons would take away from the electrical utility business the animations and talents of private initiative that have made it such a great contributor to the economic and social welfare of the United States. These men are quick to accept any published data as being competent to furnish conclusions to fit their pleas. It is our opinion that the publication of this very incomplete report by a committee of utility commissioners was ill advised. It complicates rather than clarifies the problem.

If the committee had been successful in compiling information from a good number of large and small systems, there is little doubt that the effects of diversity factor, load factor, bulk purchases and bulk generation would have produced very tangible cost data to support the large system. Nor should it be forgotten that the large system carries electric service to all inhabitants of a territory, thereby giving service below cost to many customers in order that it may develop the entire region it serves. Moreover, there are service elements in favor of large systems that do not appear on cost sheets. The relative merits of large and small systems cannot be weighed fairly on cost balances.

* * * *

Light on Inductive Co-ordination

INDUCTIVE co-ordination is the neglected child of electrical engineering in electric utilities. That is, it is neglected by all except the engineers who are told off to look after it, and they are far too few in the average utility organization. After hearing the paper by H. L. Wills which is abstracted briefly in this issue of the Electrical World, E. C. Stone, chairman of the N.E.L.A. Engineering National Section, arose and said that the average utility engineer knows too little about inductive co-ordination and should know much more about it. Mr. Stone included himself in the average classification and said that he had derived personal profit from the paper.

It is natural for industries, as it is for indiivduals, to become occupied with the problems that are peculiar to their business and to give less than adequate attention to matters that, while of small concern in their own affairs, may be tremendously important to others. So it has been with inductive interference. The electromagnetic field of a telephone conductor never impaired the service of a power line. While there has never been any disposition on the part of electric utilities in general to dodge their responsibilities concerning inductive interference, there has been the disposition to regard it as an annoyance rather than as a major problem.

But it is a major problem. Getting along *with* the world is just as important as getting along *in* the world. Industries must develop side by side and their interferences with each other must be mutually recognized for what they are, obstacles in the way of common progress. These obstacles must be removed by combined effort.

Between the electricity supply and the communication

industries this recognition has come. The joint committee work outlined by Mr. Willis indicates that both have approached the problem in a co-operative and tolerant spirit. If this were not the case, there is no estimating the chaotic condition that the future would bring—what with larger loads and higher voltages on transmission and distribution lines and vastly increased sensitivities of communication systems.

The program of the joint committee comprehends an extensive investigation of all phases of inductive interference. The results of that research, as they are attained will affect the design and operation of electricity supply systems. Therefore every electric utility engineer will need to know what the investigations include.

* * * *

Cable-Sheath Corrosion

PROPERLY constructed concrete that is sufficiently cured is not an unsafe material for cable ducts. The opinion that lead-sheath corrosion is caused by concrete arises from the idea that any mixture of cement, water, sand and coarse aggregate is concrete. It is not. Concrete is a definite material that results from careful proportioning of its ingredients and control of the mixing process. A friable, porous mass cannot be termed concrete just because it has Portland cement in it. Real concrete is solid, dense and virtually impermeable to water infiltration.

The present opinion that concrete duct is a factor in the corrosion of cable sheaths is rather widely held. But sheath corrosion was a problem for a long time before this opinion became popular. After reading the article on it in this issue one will probably conclude that it will remain a problem for a long time to come. The diversity of chemical and physical conditions due to soils, seasons and electrical operations, and the pertinent fact that most cables are nearly inaccessible to observation while in service combine to make it virtually impossible to do more than infer the factors causing corrosion. The extant literature is scanty and most of it is discursive and speculative rather than factual. As is the published material, so are the general ideas among cable operators—more opinions and inferences than actual knowledge.

The selection of concrete as the villain in the piece is not unanimous. Evidence supporting the contention that concrete is not guilty is furnished by one of the largest users of monolithic conduit. On the system of this company it is customary to pull cable into the ducts as soon as the concrete is hard enough, no regard being given to the chemical condition of the concrete. Several hundred thousand feet of cable has been thus installed, and only two or three cases of corrosion possibly attributable to the concrete have been recorded in three years. Similar corrosion was found in fiber duct. There is additional hundreds of thousands of feet of cable reposing in precast and monolithic duct all over the world—cable that has been in service for years past and will probably remain in service for years to come. There is no collection of comparative data large enough and covering a sufficiently long period of years to permit the drawing of any conclusive and convincing evidence that corrosion occurs more frequently in good concrete than in other ducts.

Lead is a metalloid, not a true metal. It is a sort of a chemical paradox. It stoutly resists the action of powerful acids and pitifully succumbs to weaker ones. These weaker solvents are plentiful in ground waters. They may be brought into contact with cable sheaths by percolation through porous concrete, through poorly made joints in ducts or through other channels. In going through porous concrete ducts or envelopes water may pick up active reagents. The important things are to insure that water shall not collect in ducts and to remember that further study of corrosion is needed.

* * * *

An Unnecessary Middleman

SIMULTANEOUSLY three public service commissions have had before them the question—troublesome in large cities—whether owners of apartment houses shall be permitted to install master meters, buying their energy at wholesale prices and retailing it to the individual tenants at the legal domestic rates, or more if they can "get away with it," while the tenant has neither the right to appeal to the commission in case of a disputed bill nor the power to force an inspection of a meter suspected of inaccuracy. The New York Public Service Commission and the Public Utilities Commission of the District of Columbia are still wrestling with this problem, but the New Jersey Board of Public Utility Commissioners has unhesitatingly declared the Public Service Electric & Gas Company justified in refusing to furnish a master meter to an apartment-house landlord who had arranged with a meter-service company to fit out his flats with individual submeters for a share of the profits.

That other commissions will follow the lead of New Jersey and that they shall be sustained by the courts, if the dispute be taken there, may surely be hoped. The central-station companies are entitled to their full domestic rates from dwellers in apartment houses, and the tenants, whose case bears no resemblance to that of transient hotel patrons or of renters of offices who have no separate meters, are entitled to the protection of the commissions.

* * * *

Interconnection Accounting Needs Simplification

CURRENT trends in interconnection cost accounting illustrate many complexities which deserve the combined study of engineers and comptrollers in the interests of greater simplification. It is not surprising that methods of measuring and billing associated with the intercompany transfer of energy are often highly intricate. The art of interconnection is young, and the establishment of procedure leading to settlements for services rendered in this rapidly developing field has been an evolution based upon local conditions, long-established ideas relative to rates and collections, the physical layout of systems and the justifiable desire to make money out of that evanescent stock in trade known as the kilowatt-hour, whether potential in the stored waters of reservoirs or disguised as the B.t.u. component of the fuel supply. The mere existence of complexities of practice, however, is no final justification for their retention.

The door to this problem is unlikely to be unlocked by a single key, but this is no ground for discouragement. It is probably too early to attempt to standardize interconnection accounting among different systems. None the less, it appears practicable to establish in more workable form for particular interconnections data and procedure applying to a much wider range of operating

conditions than have been available in many regions in the past. Excellent work has been done in the direction of calculating and plotting increment costs of producing and delivering energy, so that the decision to buy, sell or "stand pat" in regard to energy transfer may be quickly made and systematically accounted for in the records. A recent examination of a number of interconnection contracts and of the methods of intercompany billing impressed the investigator with the cumbersome procedure often embodied in allocating costs and savings to the participants, and the possibilities inherent in the use of better tabular and graphic means of expediting this business loomed large.

Haphazard handling of interconnections involves a risk of serious economic losses. It should not be difficult to work toward more effective accounting and therefore better control of pooled resources from the base of the maximum capacities of equipment, lines, water and fuel in hand and in prospect. The limitations of interchange are pretty well established in every particular case, and the tabulation and plotting of costs, prices and savings over a wide range of operating assumptions and experiences would seem worth a good deal of time and effort, with the objectives of simplifying routine procedure in support of periodical billing and clarifying developmental policies and the allocation of mutual and individual financial responsibilities. Interconnected companies may not be able as yet to escape the underlying complexities of economic relationship, but at least there is hope that through the co-operation of engineers and accountants present routine burdens may be lessened.

* * * *

New York Edison Company to Sell Appliances

FOR years the New York Edison Company has been, among the power companies of the country, the outstanding exponent of the policy of not merchandising electrical household appliances. Despite the fact that the sale of domestic load-building equipment has become almost standard practice in the industry, this great organization has restricted its activities to the display and demonstration of appliances in its many showrooms and has left the function of retailing to the department store, the specialty shop and the independent dealer. It has extensively advertised the use of electricity in the home and co-operated generously with manufacturers and dealers but has not itself participated in the appliance trade. Now comes the announcement that, under the plan of reorganization in which M. S. Sloan has been made president of the five great electric utilities of Greater New York City, this policy is to be reversed and the advocates of the old theory that the central station should furnish energy only have lost their most shining example. Cleveland and Louisville are now the only two prominent companies which do not merchandise.

Details of the plan under which the New York Edison Company will inaugurate its merchandising policy will be awaited with much interest both because the size of the system offers unusual opportunity and because of the intricate trade relationships which will be involved in so sweeping a readjustment. Out of it in the course of the next few years should come some valuable statistics.

Weight of numbers would seem to have pretty definitely settled the old debate over the issue "to merchandise or not to merchandise." Predominant opinion is now clearly agreed that the building of an economic load factor and the development of a complete service to the public demand an investment in the promotion of energy-consuming appliances that cannot be imposed upon the independent merchant alone. This is particularly true during the pioneering period when costly educational advertising and demonstration must be applied to the awakening of public interest and demand. And this is a far-reaching and constructive service to the appliance trade, provided that these appliances are sold at prices and on terms that make it possible for the independent dealer to enter the field and compete on an equitable basis. The new policy of the New York Edison Company will be carefully studied throughout the industry.

* * * *

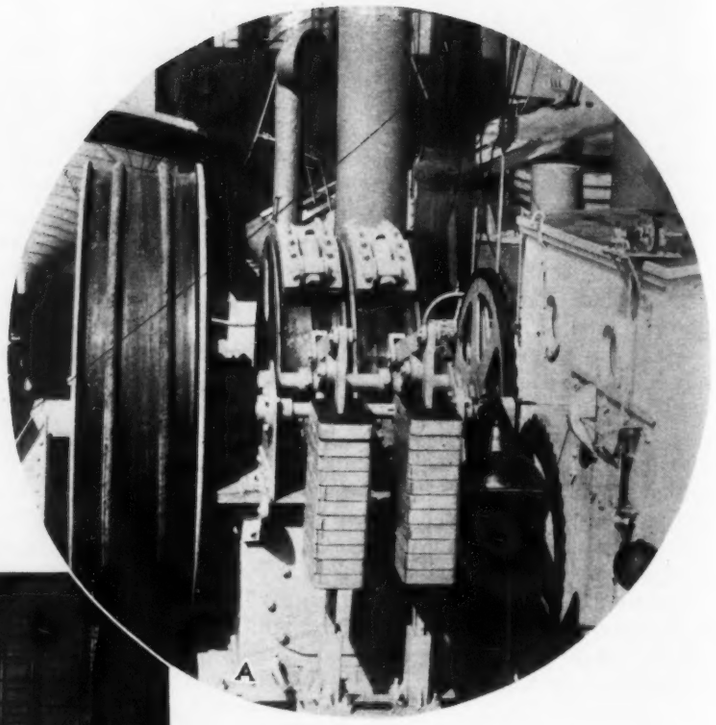
Size Limits in Turbo-Generators

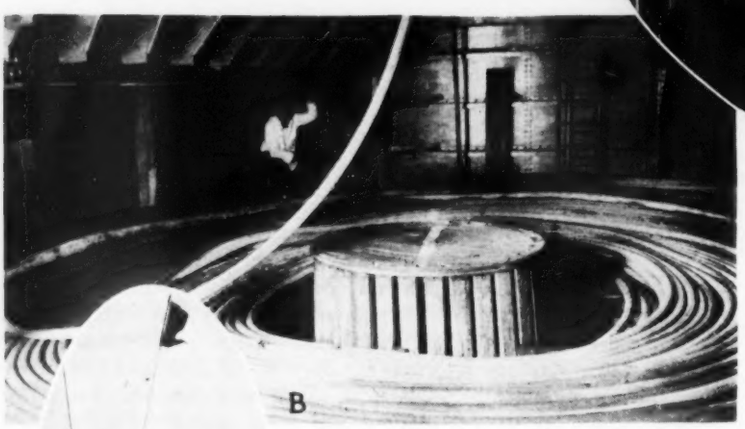
ABOUT fifteen years ago turbo-generator designers agreed that 35,000 kva. represented the maximum rating that could be considered a possibility for commercial design. As reported last week in the ELECTRICAL WORLD, two new units are going into operation in the Hell Gate station in New York each of which is rated at over 188,000 kva. This is a typical development in the electrical industry. New knowledge, better materials and greater commercial rewards all combine to move the limits of magnitude to heights undreamed of a few years ago.

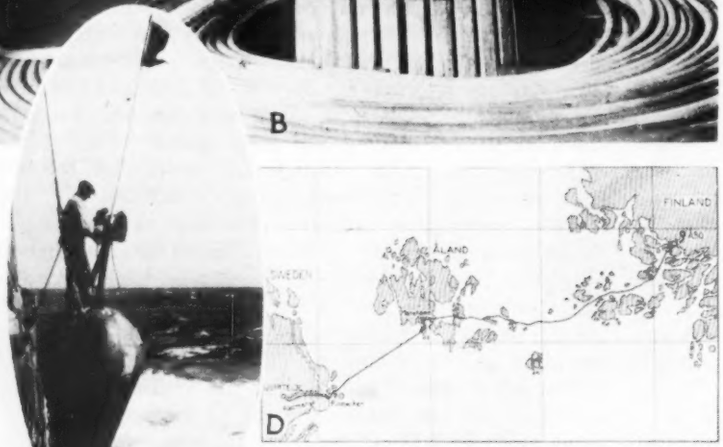
These two new turbo-generators are interesting in that one is an American design and the other the product of European designers. They are very similar in their general features. Each is a compound type with each high- and low-pressure steam unit directly connected to an alternator. In the European design the high-pressure unit has its alternator rated at 88,250 kva. at 1,800 r.p.m. and the American-made unit has its alternator rated at 94,200 kva. at the same speed. The greatest difference lies in the ratings and speeds of the low-pressure units. The European has a 1,200-r.p.m., 100,000-kva. alternator and the American a 1,800-r.p.m., 94,200-kva. alternator. Other differences are that the European machine carries an exciter on each unit while the American has the exciters for the two alternators on the shaft of the high-pressure unit and a 5,000-kw. auxiliary generator and its exciter on the shaft of the low-pressure unit. In addition, the ventilating arrangements of the two units differ as to methods of fan installation. It will be very informative to find out the difference in operating performance of these two units over a period of years.

Large units are needed to meet load demands, and in this single generating station two units aggregating 376,650 kva. are being placed in operation at about the same time. No better indication could be had of the growth of load in the New York territory. When out of commission these units carry the fixed charges on about $6,000,000 in addition to the loss of revenue from energy sales. Economic prohibitions exist to restrict to the New York and Chicago territories the present application of many of these large generators. Their large size does not bring about a great difference in thermal efficiency, and over-all economies are in favor of smaller units for most stations. But load is growing, and no one can predict the economic size of turbo-generators that will be needed in a few years. The thanks of the industry are due to the utility companies and manufacturers who pioneer in these attempts to raise design limits to higher and higher values.

Laying 132-Mile Cable Between Finland and Sweden







RECENTLY a 156-mile telephone cable was laid between the Swedish and Finnish coast which, according to George Müllenheim of Köln-Höhenberg, Germany, is the longest in the world. Out of the total, 132 miles was submarine cable. The diameter of the cable on the Swedish end was $1\frac{3}{4}$ in. and that on the Finnish end was 2 in. Water depth of 730 ft. was encountered on the Swedish section and dangerous reefs between the islands and Finland had to be crossed.

A and E—Views of the paying-out drum and brakes.
B shows a 25-mile coil of cable in the hold of the S.S. *Norderney*.
C—Cable buoy being launched.
D shows the route.
F—Cable being landed from a lighter.

Consolidation

*Its Benefits and Obligations**

Consolidation an inevitable development. National pooling of knowledge basis for phenomenal growth. Advantages of consolidation in Greater New York. Inherent obligations of utility and individuals to public

By MATTHEW S. SLOAN
President New York Edison Company

M. S. Sloan

THE entire trend of business in our nation is toward larger units, toward combinations to reduce expenses, to improve commodities or service supplied to the public and to reduce prices as and when possible. In our industry it has been a natural evolution, a mark of progress in our work, an inevitable development for the better carrying out of our task. It has resulted in notable improvements in the service supplied to large areas of our country and its results in price reduction have been evident.

The union of electrical companies into strong trade organizations has certainly not resulted in restriction of service at the disposal of the public. It certainly has not resulted in increased prices, either by restriction of service or by agreement to force customers to pay more money for what they buy. Quite the contrary. It has increased the general fund of knowledge, permitted the adoption of higher standards of service and by discussion and example has tended to bring about the lowering of prices wherever conditions permit. These, surely, are not the results usually attributed to a trust or any appurtenance of a trust.

Under public regulation we have not had the business rivalries and jealousies to handicap us in the development of strong and efficient trade organizations which many businesses have encountered. There have been no manufacturing processes and trade secrets to safeguard from aggressive competitors. The discoveries, methods, practices found by any one of our member companies to be advantageous have been freely disclosed to all others to be adopted and applied in their judgment for their benefit and the benefit of their customers. I think this fact, as much as any one thing, has been responsible for the remarkable advance of our industry in its methods and its standards of service.

NEW YORK CITY OUTSTANDING EXAMPLE

We in Greater New York are engaged in one of the most important and interesting developments in connection with furnishing electrical service in this territory of any which have occurred since the very beginning of the central-station industry with the opening of the Pearl Street plant. Here is a group of major electrical companies serving a very large part of New York City, united in management as well as ownership and other companies associated through common ownership, which take in a considerable territory outside of New York City proper. The whole group is being created into a system unified in ownership, control, operation and management. Taken as a unit, it is the largest electrical utility in the world—the largest in investment, in number of customers, in service facilities and in the amount of service sold. It is the largest also in opportunity for service to the public. The total investment in service facilities — generating stations, substations, transmission and distribution lines—is approximately one billion dollars. There are five chief generating stations with others in reserve having a present installation of more than 1,600,000 hp. Each, when developed to its full size, will have an installation of more than 1,000,000 hp. and one, according to present plans, will reach more than 1,500,000 hp.

When it can be done, these companies in the system will be consolidated into one company as the final process in unifying operations and sim-

Mr. Sloan Asks:

What has the public a right to expect from us?

What has the public a right to demand from us?

What is the public not getting which it should have from us?

What are we doing in our relations with the public which we should not do?

When those questions have been honestly and sincerely answered, and the answers are translated into action, service which is not only good but also satisfactory to the people will result. Then the utility will become truly what it ought to be—a service organization.

**Excerpts from recent speech before Bond Club of New York and Metropolitan Section of N.E.L.A.*

plifying the situation in respect of service. It is my ambition to see it the leader and best example as to quality of service and enlightened and liberal policies in its relationship to the public.

There is no reason why a public service company should not be so well operated, should not furnish such high-grade service and be so well known and understood by the people it serves that they will be proud of it as an outstanding local institution. I hope to see our utility occupy that position; to see it known and recognized as an honest, trustworthy, valuable public servant and respected and esteemed on those grounds.

The advantages of consolidation are not so obvious, perhaps, to the general public, and yet the proceedings before the Public Service Commission as a result of which the consolidation was authorized made it apparent that they were appreciated, at least in general outline.

Chief among these advantages is the fact that this consolidation brings interconnection into effect in day-to-day operation, instead of as an emergency measure or something to be used only under special conditions. Operation as a system wipes out company lines in the dispatching of power. It means the obtaining of maximum efficiency and economy in the use of all the plants in the system in handling the load.

Operation as a system means the possibility of applying technical improvements, advances in the art, at once and on a large scale instead of piecemeal, company by company. It means the most complete and efficient employment of capital already invested in plants and equipment because we can keep the most efficient generators working to their full capacity, using the least efficient ones only when we have to. Because the stations are tied together we need to maintain less idle generating capacity in reserve and so have the least possible unemployed investment.

Operation as a unit reduces the requirements for new capital investment to care for future growth in the territory served by the system. When new financing becomes necessary it means that money can be hired on the most advantageous terms; even more advantageous than had been possible in the past, although the companies as individual entities were large enough and sound enough financially to command good credit and good terms in acquiring new capital. It means economies in purchasing materials and equipment and in administration. It means the possibility of unified policies of operation, of merchandising, of customer relations and of relations with the general public.

In short, the consolidation of these companies into a system represents the maximum possibility of efficiency and economy in all departments and phases of public utility operation. It presents the maximum opportunity for supplying the highest grade service to the public, and, by reason of the economies that are achieved, of selling that service to the public at the lowest possible price.

We are under mandate as a part of the conditions on which we are permitted to make this consolidation to share the benefits obtained from it with the public. This we intend to do, not alone because we are expected by the state-regulating authorities to do it but first and foremost because it is our duty as public servants to do it. Public service corporations occupy a relationship toward the public which is different from that of any other business organization. The law says they are "affected with a public interest." Any consideration of the relationship of utilities to the public, therefore, must begin with that fact and never get away from it. Our companies have certain privileges for the use of rights or property of the public which other businesses do not enjoy. The companies pay for these privileges in various forms of taxation, and this use of public property is permitted in order to enable the companies to furnish a service which is essential to modern living, reaching all the people with it as they could not be reached without such use of the public streets and highways.

Nevertheless, these privileges are granted to us by the public. Without them we could not do business and our business produces profits, as that term is ordinarily understood, for those who have invested in it. Moreover, we have exclusive right to furnish electrical service to the public in our franchise territory. This is granted to us by public authorities and is for the benefit of the people because a public utility is recognized as what the economists call a natural monopoly. Still we do have this monopoly privilege, and it is for our business advantage.

In consideration of the privileges it grants to us the public regulates us as to standards of service, as to rates and as to capitalization, but because it does more for us than for others it expects more from us, and I hold that it has a right to expert more from us. The law obligates us to furnish safe and adequate service at fair and reasonable rates and the Public Service Commission is empowered to check us up and see that we comply with the law. There can be no discrimination; each customer, according to quantity and conditions and time of use of service, is entitled to receive and must receive the same quality of service and pay the same price for it.

Mere compliance with the law's provisions would not be enough for us. We have to live up to the spirit of those requirements. It was to enable us to do just that that this consolidation of companies into an electrical system serving the Metropolitan district was brought about. We are trustees for the interests of the public as well as trustees for the thousands of individuals, the trust funds, insurance companies and other investment organizations whose money makes the service possible. There is here no conflict of interest or divided allegiance. We can do our duty to both with success only as we

Rates and Dividends

The utility with intelligent management makes rates as low as possible in order to stimulate business, to stimulate the growth of the community, which inevitably means more homes and more business establishments for it to serve.

It may adopt this course only because of what the great philosopher William James termed "enlightened selfishness" or it may adopt it from the combined motives of business judgment and public spirit.

The result is the same: mutual benefit for customers and company. This condition is so basically true that it might be set down as guiding principle No. 1 in public utility operation in about these words:

Serve your people well and dividends will take care of themselves.

fulfill our obligations to the public in the most complete measure. As a trustee for the owners, the management must conduct a sound, successful, even a prosperous business. Unless it does that it would fail in its duty to the public because it would be unable to furnish the highest grade of service; it would be unable to command credit on the best possible terms, and so could not provide as it should for the future electrical requirements of this great territory.

We have all seen it work out in the transportation business of many cities. Held down to rates out of proportion to present-day rates of operation, their service has suffered and the public dependent on them has suffered. Only when adequate revenue is provided are they able to do their job properly.

Let us consider what we, as a public service organization, owe to the public: First, we owe, obviously, a technical service which shall be just as safe and as unfailing as the very best brains of the technicians can produce. We owe a service ample to supply every demand that can be made on it at any moment of day or night. That means that our plants and distribution facilities must be built well ahead of the demands as we calculate them from year to year, and they must be kept up to date, equipped with the most modern generating machinery and operated according to the highest standards of the electrical art.

There is no reason why a public service company should not be so well operated, should not furnish such high-grade service and be so well known and understood by the people it serves that they will be proud of it as an outstanding local institution. I hope to see our utility occupy that position; to see it known and recognized as an honest, trustworthy, valuable public servant and respected and esteemed on those grounds.

We owe a service which is broadly human and helpful to our customers. This means that all of our people, all of us engaged in servicing the public, must be alert, intelligent, well trained in our duties, courteous in all contacts with the public and possessed of a desire to do everything we can to make our service useful to the customers in every way. The public has a right to expect from us such conduct of our business without complaints, nagging, prodding by individuals or property owners' associations or civic groups or public officials.

What Public Service Demands of Management

We owe a management which is honest and square dealing, which is efficient and economical in its handling of the companies' affairs, which is sensitive to public opinion, particularly to the public's needs and desires, and willing and anxious to meet them. We owe a management which is broad-visioned so that it can plan for the future while operating satisfactorily in the present. We owe a public policy which takes cognizance of all of these matters and earnestly and sincerely endeavors to translate them into facts which are a part of the daily routine of operation. We owe a public policy which recognizes that the public and the public utility are in effect partners, and which therefore shares without hesitation and without quibbling the benefits derived from efficient and economical operation between the investors in the utility and the customers of the utility.

Briefly stated, those are the obligations of the public utility to the people as I see them, and this consolidation of companies was brought about so that we might be in better position than ever before to live up to those obligations.

Now what does this require of us as individuals, and all of the others among the 30,000 employees of this system? As I see it, it requires an absolute and complete realization that this job of ours is a job of public service. That means that we must furnish 100 per cent devotion to the public interest. To do this we must put 100 per cent effort into our jobs and give 100 per cent loyalty to our organization. I regard it as elementary that the public utility is no place for hangers-on, or time-servers, for office politicians and others of that ilk, for people with outside business interests or aspirations and ambitions which will divide their loyalty, interest and effort between these outside interests and their jobs.

Teamwork is needed to accomplish the task; organization effort by every person from top to bottom in the organization. The meter reader, the repairman, have their part in this effort just as much as the president, and it may well be that their part is somewhat more critical because in the course of the day's work they meet and have contact with many more customers than the president does.

Let us try to catch the vision of this situation we must work toward. Here are a million homes dependent on us for electrical service to make life easier, better, happier. Here is a great industrial community and we've got to supply the power to keep its thousands of machines moving. Here is the greatest commercial, trading and financial center in the world with its vast hotels, stores, theaters, public buildings of every nature using our service and dependent on it. Here are 6,000,000 people going about their daily affairs, their lives woven together into the complex pattern produced by modern civilization in a metropolis. This city could not function without our service. Its affairs would be disrupted, hurled into chaos, if some inconceivable event should put our plants and equipment out of business. And so whatever we do to better our service, to improve our operation, to make electricity more useful and more widely available, is of direct and measurable benefit to those people and the community.

What a responsibility rests on us! What an opportunity for service is ours! The degree to which we do meet it will be the measure of our fitness for our work.

Reserve Capacities in Sixteen Substations*

ONE of the important elements in the economic design of an electric system is the reduction and maintenance at a minimum of the margin of capacity between the installed capacity and the peak load. A certain amount of capacity will be required in order to obtain the necessary spare so that the failure of any element of the system will not endanger the service rendered. The economic provision of spare capacity is one of the most important features involved in economic design. The reason for this is that normally economy is in favor of larger units in the transmission system, in substations

**Based on material compiled by substation subcommittee of the electrical apparatus committee, N.E.L.A.*

Spare Capacity in Percentage of Peak Load

Company	Spare Feeder Capacity, Per Cent	Spare Transmission Capacity, Per Cent	Spare Transformer Capacity, Per Cent
A	20 continuous, 50 for period of one hour	...	20—33.3
B	20	25	0
C	0	...	20
D	10	33	33⅓
E	50 in downtown district, less in outlying districts	50	33⅓
F	25	40	25
G	25	One reserve 6,000-kva. feeder per substation	Variable; one reserve 7,500-kva. bank in each substation.
H	12.5	...	.....
J	0	...	.....
K	25	30	.....
L	30	20	20
M	....	20	50—100
N	50	25	20
O	....	...	10— 25
P	....	0	25— 50
R	30	33⅓	30— 50

and in the distribution system. The larger the units as a rule the greater will be the percentage of spare capacity due to the introduction of a spare unit, consequently unless the blocks of power handled are extremely large due to very high load densities, economic limitation is imposed upon the size of the units in the various parts of the system. The table summarizes the data given by sixteen representative companies.

Co-ordination Well Under Way

Program of investigation intended to arrive at facts that can be applied to solution of specific problems. Scope of research contemplated

"IN THE ordinary walks of life if one person interferes with another in the conduct of his business or his social life there have been established certain codes which are interpreted under the rules of law by the courts and which determine the duties of each party. But when interference with the operation of one electrical circuit with the operation of another electrical circuit occurs there are no commonly accepted codes that may be referred to to determine the equitable assignment of duty to each party operating these circuits."

Thus commented H. L. Wills, chairman of the national inductive co-ordination committee, in a paper read by G. J. Hemstreet at the recent meeting of the Great Lakes Engineering Section, N.E.L.A. After instancing the growing importance of the problem of inductive co-ordination which is caused by the large and steadily increasing amounts of power transmitted and distributed, and the consequent increase in voltage of both types of circuits on the one hand and by the relatively higher sensitivities of communication equipments on the other, Mr. Wills went on to detail the work his committee has now in hand, as well as that which is planned for future investigations:

"Co-operation between the National Electric Light Association and the Bell Telephone System has resulted in a mutually accepted code of principles that, as between these two organizations, stands as a basis upon which adjustments of problems arising through inductive interference can be effected. Also, some few practices that should hold have been agreed to. These practices, however, lack the one essential feature which would place them in workable form; that is, they do not contain the quantitative values that are so necessary to direct application in field work. Our problem now is to expand these practices to cover all our needs, and to do this we must know the extreme limits to which co-ordination measures can be carried out in both systems. Then we must decide how far these measures may be carried in either or both systems, and not unnecessarily restrain advancement in the arts, or bar the further expansion of the services by reason of prohibitive costs.

"We have organized a joint development and research committee, and to this committee is assigned the task of securing the necessary data which will make it possible to prepare a code of practices that may be applied directly as working tools to the field problems of inductive co-ordination. This subcommittee has undertaken its work through the establishment of eleven project subcommittees."

The program before the project subcommittees is summarized in the box in this article. Although this statement is brief and the points in the program are merely mentioned, the work that the committee has undertaken is almost monumental in scope. It includes studies extending over long periods of time and wide areas of country and will require an immense amount of very painstaking detail observation. Some of the projects are already started; in fact, have been in progress for years; others have not yet been begun because they require preliminary surveys, now in hand, to establish the most profitable fields of investigation. It is hoped, however, that this summary will be sufficient to indicate to men in other branches of the electric utility industry the importance and complexity of the problem.

Program of Inductive Co-ordination Committee

Subjects assigned to eleven project subcommittees

I.—Unbalance of telephone circuits. Longitudinal propagation of induced voltages and currents. Shielding. Effects at ends of exposures. Cumulation of successive exposures. Co-ordinated transpositions.

II.—Telephone system protection. Operation and performance of protective devices. Importance of telephone protection. Improvement of methods and devices.

III.—Magnitude and distribution of power system residuals. Effects of residuals.

IV.—Effect on speech reception of noise from external causes. Survey of present conditions. Methods of measuring noise.

V.—Improvements in wave shape on power systems. Economic comparison of methods with benefits possible of attainment.

VI.—Joint use of poles. Co-efficients of induction. Transpositions and other interference eliminators.

VII.—Power level and sensitivity of telephone circuits. Ratio of extraneous to telephone power.

VIII.—Selective devices. Suppression of selected frequencies. Application to both power and communication circuits.

IX.—Interference with carrier telephone circuits. Sources of interference. Induction at carrier frequencies. Unbalances at carrier frequencies. Attenuation characteristics. Longitudinal propagation of carrier frequencies.

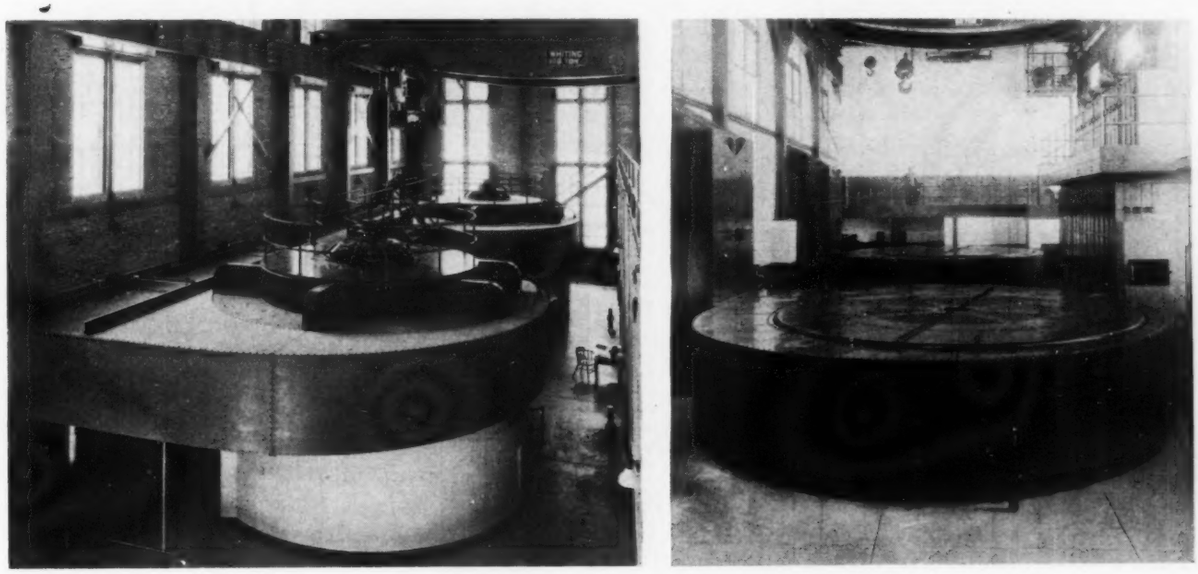
X.—Frequency response of telephone receivers and transmitters.

XI.—Special devices and methods. Drainage connections. Neutralizing and sectionalizing transformers. Applications to power and communication systems.

Umbrella Type Generators

Vertical units designed for hydro stations have revolving field and combine operating advantages with design features. Eight installations of sixteen units have excellent service record

By A. C. CLOGHER
Hydraulic Engineer Electric Bond & Share Company



Typical umbrella type generator installations

The Soda hydro-electric development of the Utah Power & Light Company (right) is provided with two separately excited 7,000-kw. generators. The Cutler station of the same company (left) has two 15,000-kw. machines with direct-connected exciters.

IN ALL the hydro-electric stations designed by the Electric Bond & Share Company since 1920 and provided with vertical units in which the diameter of the main generator rotor is several times its depth the conventional scheme of placing an oil-lubricated guide bearing both above and below the rotor, with the thrust bearing mounted on a bridge above and spanning the stator frame and with a direct-connected exciter above the thrust bearing, has been abandoned in favor of a design which has been called the umbrella type generator with revolving field. It is not to be confused, however, with one installation of the so-called umbrella type generator with revolving armature, installed at Niagara Falls more than twenty-five years ago.

In the umbrella type generator with revolving field the spokes of the conventional rotor for vertical units have been constructed on a slope, so that the center of the pole pieces is located some distance below the center of the hub. The rotor is located at the top end of the shaft and the revolving element is supported and guided by a thrust and a guide bearing immediately below the rotor and by a second guide bearing immediately above the turbine runner.

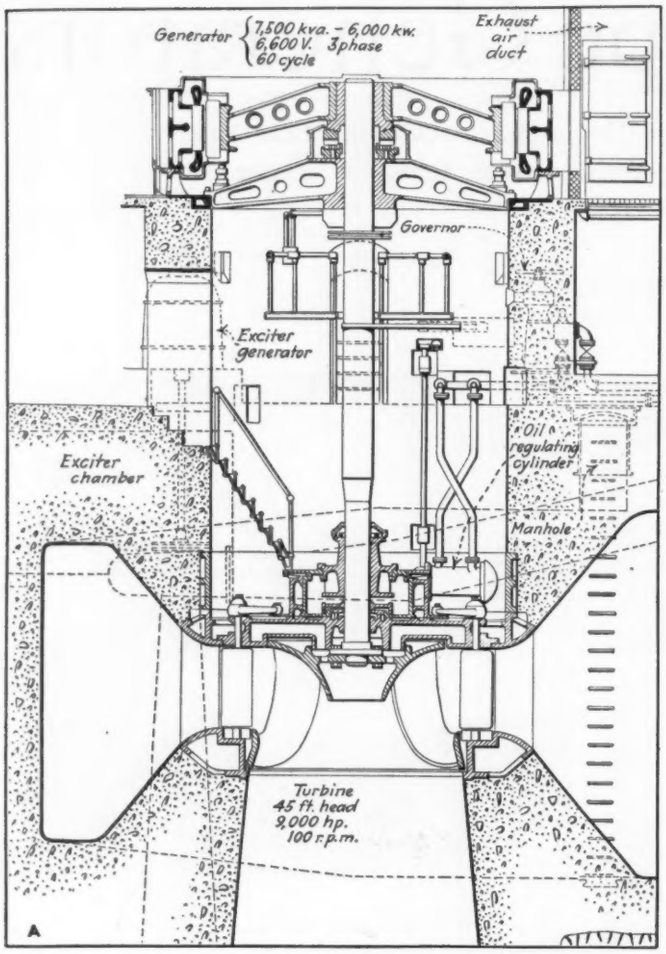
It is probable that the idea first sprang from the desire to design a station having all of the auxiliary apparatus and moving parts of the plant so located on one floor that a station containing one or two small units could be successfully attended during the greater part of the day by one operator. The original development of this idea provided for a direct-connected exciter between the generator and the turbine, but this location for the exciter was never adopted in any of the plants constructed.

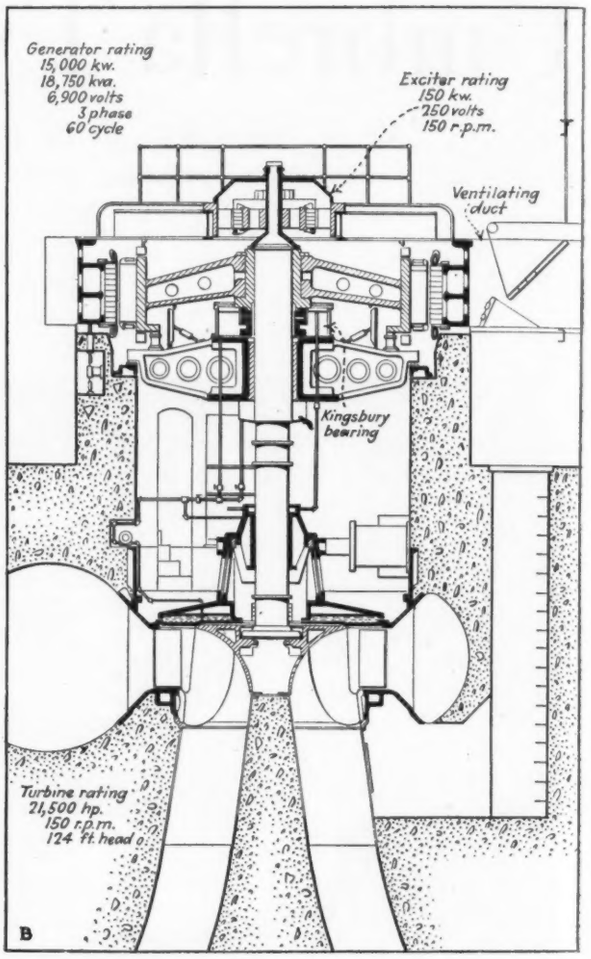
In the study for this type of plant it was assumed that the main generator itself, exclusive of all auxiliaries, was a machine which, when once set up properly, needed no direct attention in so far as the field and the armature were concerned, and that continuous access or attention to these parts by the attendant was not necessary. Access to the thrust and guide bearings, to the slip rings and to the turbine deck, however, was considered desirable as it was believed that these were parts of the unit which should receive attention occasionally by the operator.

The resulting design provided for all of the auxiliary machinery and the control room to be located on the floor just above the turbine scroll case. From this floor it is only a few steps down to the turbine deck and a few steps up to the slip rings, the generator supporting bridge, the upper guide bearing and the thrust bearing.

In accomplishing the results desired for operating a small station with one attendant several other advantages in the design of the unit developed and, consequently, this type of unit has been deemed desirable even in stations having a large number of units and units of fairly large capacity.

In the conventional generator the custom has been generally to pass the ventilating air into the generator in





Exciters may be direct connected or separately mounted

(A) The Blanchard development of the Minnesota Power & Light Company has a 6,000-kw. Allis-Chalmers generator and turbine.

(B) The Cutler station is provided with a 15,000-kw. General Electric Company generator and I. P. Morris Company turbine.

such a way that it has flowed with great velocity past either one or both of the guide bearings adjacent to the rotor. It has been found very difficult to prevent oil vapor escaping from these guide bearings, and this oil vapor, together with dirt which may be in the ventilating air, often makes a deposit on the windings of the generator which seriously affects temperature conditions and is difficult to remove.

In the umbrella type generator it is found quite feasible to have the air enter either the top or the bottom of the stator and, by means of baffles, partially stationary on the bridge and partially fixed to the rotor frame, to keep the ventilating air passages entirely away from both the thrust bearing and the guide bearing.

In practically all of the hydro-electric units of moderate head the diameter of the pit necessary for accommodating the turbine is much smaller than the bore of the stator frame for the corresponding generator. In the umbrella type machine the bridge supporting the thrust bearing has to span the much shorter diameter of the wheel pit instead of the bore of the generator stator and is therefore materially lighter in weight. Relieving the stator frame of the bridge and the whole rotating element of the unit reduces the weight of the stator.

In order to get at the field coils or armature coils of the generator it is necessary only to remove two keys holding the rotor in place, after which it can be jacked off of the supporting collar and raised or removed so

Installations of Umbrella Type Hydro-Electric Generators with Revolving Field

Operating Company	Name of Plant	Year Started in Operation	No. of Units	Capacity in Kw.	Speed, R.P.M.	Head, Ft.	Method of Excitation
daho Power Co.	American Falls	1923	2	6,000 each	120	48	Motor-generator sets
Minnesota Power & Light Co.	Fond du Lac	1924	1	11,000	120	78	Waterwheel-driven exciter
Utah Power & Light Co.	Soda	1924	2	7,000 each	150	76	One waterwheel-driven exciter
Minnesota Power & Light Co.	Blanchard	1925	2	6,000 each	100	45	Motor-generator sets and one waterwheel-driven exciter
Utah Power & Light Co.	Cutler	1927	2	15,000 each	150	124	Direct-connected exciters
Idaho Power Co.	American Falls	1927	2	6,000 each	120	48	Motor-generator sets
Inland Power & Light Co.	Lewiston	1927	2	5,000 each	138.5	35	Motor-generator sets
Carolina Power & Light Co.	Norwood	1928	3	1–18,000	75	70	Motor-generator sets
				2–22,000	90		
Totals			16	163,000 kw.			

that both the field and the armature may be made available for inspection and repairs. In the conventional generator, for such an operation, it is necessary to remove the exciter field, and sometimes an exciter steady bearing, then to take the unit off the thrust bearing, so that the latter and the supporting bridge can be removed from the generator stator. In addition, the oil and the water piping appurtenant to the upper bearing must be dismantled and removed. It is then possible to start removing the keys from the generator rotor, the starting point for dismantling the umbrella type generator, after the sheet steel cover has been taken off.

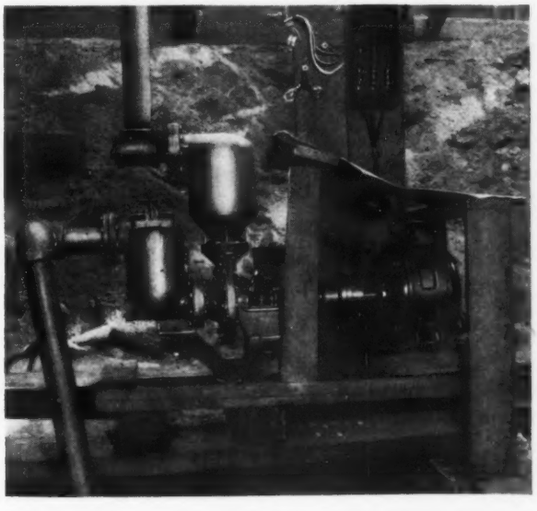
In all of the units having umbrella type generators, so far installed, it has been found feasible to utilize only two guide bearings, one directly beneath the generator and the other, always oil lubricated, directly above the turbine. There is some saving in the cost of the unit in the elimination of a third guide bearing, which would have been provided had these installations been of the conventional type.

The novel features of this arrangement for a hydroelectric unit are entirely mechanical and affect the electrical features of the generator in no way, excepting in the method of excitation. In this respect it has been found, in most of the installations made to date, to be desirable, but not necessary, to excite by some means other than with direct-connected exciters.

The accompanying table shows the extent of the installations of these generators made to date. Seven generating stations containing them are now operating and the total time of operation accumulated to date amounts to about 35 unit years. All of the units installed are operating successfully and in none of them has any mechanical difficulties been experienced, nor have any drawbacks to this type of generator developed.

Self-Priming Pump for Unwatering Excavations

By H. T. Rogers
Assistant Superintendent of Underground Construction
New York & Queens Electric Light & Power Company

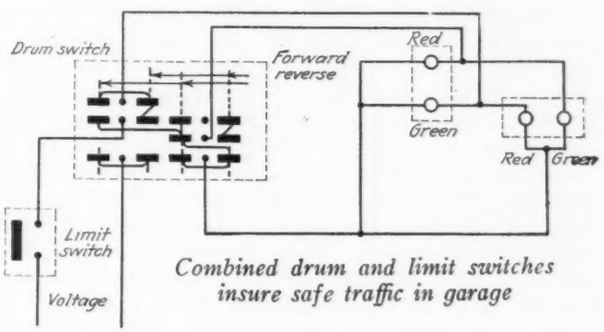


A COMPACT self-priming motor-driven centrifugal pump has been found very serviceable by the New York & Queens Electric Light & Power Company for unwatering excavations, pumping sumps, manholes, etc. It is reported to handle air, and water containing grit and sand, as there are no bearings in the pump case. Self-priming is obtained by the use of the chamber attached to the delivery side piping system. In a recent test this 150-g.p.m. unit delivered a full stream of water on a lift of 16 ft. and a discharge head of 25 ft. without difficulty. It measures 40 in. x 15 in. x 34 in. and weighs 460 lb. with its a.-c. motor. Units are available in capacities of 50 to 2,000 gal. per minute at 1,100 to 1,800 r.p.m. With direct-current drive the 150-g.p.m. unit weighs 546 lb.

Industrial Control Devices Protect Garage Traffic

By R. E. Clisdell and D. F. Richardson
General Electric Company, New York, N. Y.

A NEW traffic control installed in the Uppercu-Cadillac Corporation garage in New York City utilizes two industrial control devices to operate the traffic signals, accomplishing the desired results in an inexpensive way



Combined drum and limit switches insure safe traffic in garage

for this strictly modern building. All cars sent to this garage are brought to a test floor in the building, where they are inspected to determine what repairs are necessary. They are then sent upstairs by elevators to the floor where the repairing can be done. There are two ramps by which cars may enter and leave the test floor, each entering from a different street. Near the entrance of the ramps on either street is located a vertical two-section bracket signal showing red and green and at the foot of the ramp is a horizontal bracket signal. On the wall near the entrance from the ramp to the test floor is a drum switch to control the lights. This equipment is duplicated for the other ramp.

The signals are so connected that when a car is entering the ramp from the street a green indication will show in the vertical bracket signal and a red indication will show in the horizontal signal, indicating to the cars leaving the test floor that a car is about to enter. When a car is leaving the test floor, green is shown in the horizontal signal and red is shown in the vertical signal. The doors are electrically operated by means of a control purchased through the Allen-Drew Company of Boston, and in conjunction with this company's electric equipment a General Electric Company limit switch is used, so that when the doors are closed the signal lights are shut off regardless of the position of the drum control switch. This allows the operator to throw whatever indication he desires on his signal and then open the door, having the lights come on at the same time. With this positive control traffic may move in either direction without possibility of an accident.

Control of
Multiple Street Lighting

Relative merits of large and small relay systems established as a result of a comparison of costs and fundamental performance characteristics

By GEORGE I. MACKENZIE

ONE of the most important factors to be considered when planning a multiple street-lighting system is the question of remote control. The system should provide the means necessary to either light or extinguish the lamps at any time. It should therefore be positive in its action and at the same time economical in operation. A group of multiple street lamps may be controlled in several ways, but the device common to practically all modern systems is simply a small, low loss, relay or switch that can be readily energized or de-energized from a low potential supply. The relays may be large and have sufficient capacity for several lamps, or their current-carrying capacity may be so small that one relay controls but one lamp. Manufacturers have recently developed several sizes and styles of relay, and with certain modifications in particular cases they appear to meet satisfactorily the needs of the industry. One important factor in the construction of these relays is the conservation of space, and there are relays available with current-carrying capacities from zero to 25 amp.; small enough to be installed in the base of an average-sized ornamental street lamp post.

The relays may be operated by means of (a) a control wire extending back from the multiple section to a substation; (b) a control wire extending to a time switch; (c) a control wire extending to a series contactor that picks up the required energy from a commercial secondary, and (d) by means of high frequency carrier current.

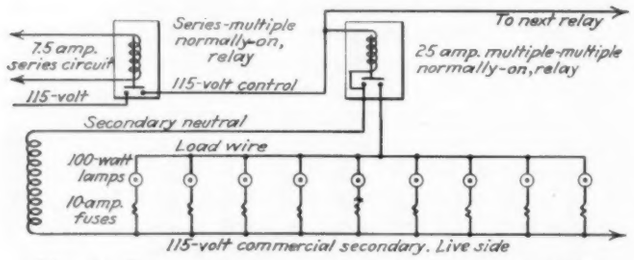


Fig. 1—Large relay controls group of street lights

Since there is a constant potential of 115 volts at the lamps, it is only necessary to ground any point of the load wire in order to light the lamps. It is therefore the function of the 25-amp. multiple-multiple relay to make the connection to the secondary neutral.

To select one of these four methods of remote control requires a study of the existing conditions, taking into consideration the distance from the substation to the section in question, the reliability of time switches and carrier currents, etc.

One section of the circuit that may be employed when a large relay is used is shown in Fig. 1. The relay should be located centrally in the section to minimize the voltage drop to the extreme lamp. A bus wire or load wire running throughout the entire length of the section is required; this wire is connected to ground through the contacts of the relay. The operation of the relay, therefore, results in making or breaking the ground connection to each lamp. A constant potential of 115 volts is maintained between the live side of the secondary and the load wire, and by placing the relay at the midpoint of the section the voltage drop from the relay to the end of the section is reduced to a minimum. The approximate length of this section should not exceed 1,000 ft., and since the lamps are balanced on each side of the midpoint there will be no appreciable difference in the intensity of illumination at any point. The actual magnitude of the voltage drop to one end of the section will depend, of course, upon the size of the wire used throughout the section.

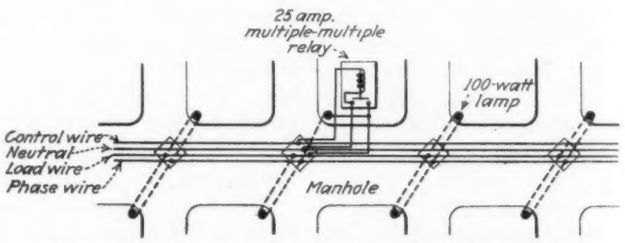


Fig. 2—Installational layout for multiple relaying

The relay is installed in the base of the adjacent lamp-post. It may be noted that only two wires are required to run from the manhole to each lamp-post except in the post containing the relay, where four wires are necessary.

To include a complete multiple district under this scheme there will be several sections nearly identical with the one shown in the figure, and the control wire will run directly through the entire group of sections. It will be tapped off at each relay and grounded to the secondary neutral. The current drawn by the relay coils is small under normal operating conditions and the inrush current required to open the contacts is only a fraction of an ampere. A No. 6 control wire is therefore large enough to control quite a number of relays of this type, providing, of course, that the distance between each relay and the distance from the source of supply is not excessive. Roughly speaking, a No. 6 control will satisfactorily operate 25 to 35 relays per mile. A detailed sketch of the relay connections and an indication of the number of connections that must be made in the manhole is shown in Fig. 2. All the underground cable is assumed to be lead covered, so that the connecting or splicing cost

is an important item. The cost of splices in the lamp-post base will be disregarded.

A typical layout of the street lamp-posts and manholes along a business street is shown in Fig. 3. In such a layout it is common practice to run fiber ducts from the manholes to each lamp-post. The connection or tapping of cables in the manholes may in some cases require

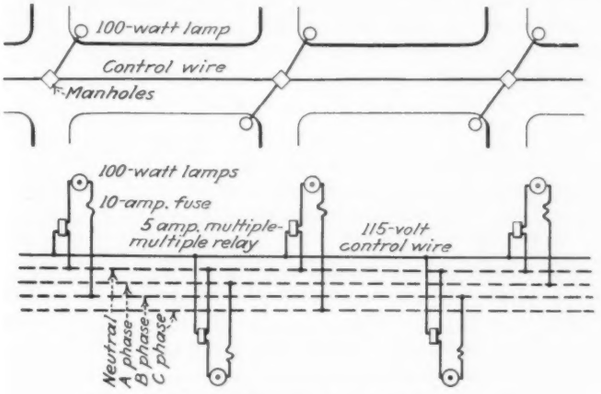


Fig. 3—Typical layout for business street

An example of the system employed when a relay is used for individual lamp control. The lamps should be balanced equally across each phase of the secondary network.

splices, but where secondary sectionalizing units are used the various services can be taken directly from this unit, thereby eliminating the expensive work of splicing a small service wire to a live, lead-covered secondary cable. The neutral wire may of course be tied in to the secondary neutral quite readily, since no particular precautions are necessary. Where the control wire is tapped, however, it is necessary to make a waterproof wiped joint. Where distribution boxes or pull boxes are required it is usually customary to make waterproof splices between the service wires and the main cables.

Several Fusing Methods Available

Several plans are available for the individual fusing of lamps. One method requires a fuse block and fuse mounted on the mast of the lamp-post in a position that is readily accessible for inspection and replacement. An alternative is to use a standard weatherproof socket with a screw type fuse and to connect this socket in the live side of the service to the lamp. This may also be installed in the base of the lamp-post where access is easy.

Where one relay is used to control several lamps the number of feet of control wire required is less than where the control must be brought into each lamp-post to operate individual lamp relays. The cost of the control wire is therefore less where only a few relays are used. The same condition is found in the number and cost of splices. With only a few relays in use the total number of splices required is less than where individual lamp relays are installed, and the splicing cost is therefore proportionately smaller.

Another item that must be considered is the lost energy cost per year in the relay coils. The large capacity relays require more energy to operate than the smaller ones. In the large relays a heavy current is flowing through the contacts and considerable energy is required to break the circuit. The large switch contacts are also larger and heavier than the small ones and gravitational force must be overcome in order to break this contact. Roughly speaking, it requires three times as much energy to operate a 25-amp. relay, as it takes to operate a 5-amp. relay. In either case, however, the cost of the energy consumed in one year is only a fraction of $1 per relay. The general scheme employed where one relay controls only one lamp is also illustrated. It is fundamentally the same principle as the group control from one relay, but each system has some comparative advantages over the others.

If a study is made of a particular job, the object being to determine accurately just which system will be the most economical to install and operate, then the following points are among the most important that should be considered: (1) Relay cost; (2) wire and cable cost; (3) splicing cost; (4) lost energy cost; (5) fusing cost.

Each of these items could be capitalized on a yearly basis, taking into account fixed charges and operating charges, and a comparative table could be prepared showing the relative economic advantages of one system over the other. As the result of such a study it was found that a slight saving results from the installation of the small relay control system.

If one of the large relays fails to operate due to either a mechanical or an electrical fault, then all the lamps controlled by this relay will remain either lighted or extinguished until the fault has been corrected. In other words, the station operator is unable to control the particular group of lamps until the relay is put in a satisfactory operating condition. If it so happens that when the control wire is de-energized one group of lamps fails to light, then the number of outages is a matter of serious concern. With the alternative method of using one relay per lamp, if the relay fails to close at street lighting time, then but one lamp is affected. Since individual lamp control requires the installation of many relays, the possibilities of relay failures are increased, but in general, from the point of view of continuity of service, the balance tips in favor of the individual lamp control.

Another advantage of the individual lamp control system is that the lamps have a more uniform intensity of illumination. Each lamp is connected directly between

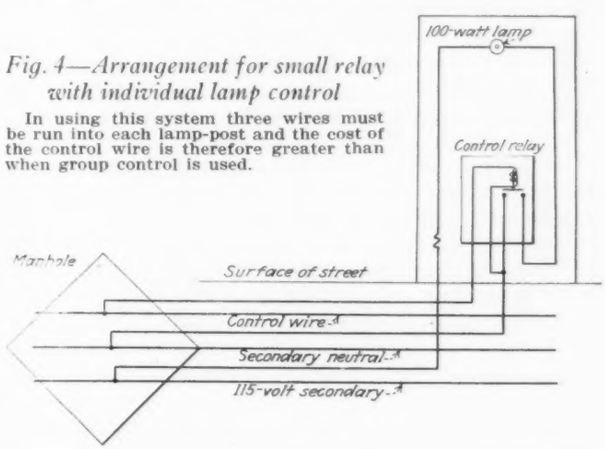


Fig. 4—Arrangement for small relay with individual lamp control

In using this system three wires must be run into each lamp-post and the cost of the control wire is therefore greater than when group control is used.

the secondary and ground, and where the secondaries are networked properly the voltage at all points should be nearly the same. Using the large relay there is certain to be a voltage drop in the load wire, causing the lamps at the extreme end of each section to be slightly dimmer than the lamps nearer to the relay. The initial cost of the large relays is, roughly speaking, twice the cost of the smaller ones. On a larger multiple street-lighting job of 50 or more lamps the large relays necessary for the job

will cost considerably less than the required number of small ones, and since the length of service that each type will provide will be nearly the same, it is more economical in this respect to use the large relays.

Summarizing the relative advantages of each type the results are briefly as follows:

Large Relay.—(1) Small initial cost; (2) small number of spare units required; (3) small possibility of a relay failure; (4) relays are well built and substantial; (5) relatively easy to take on additional loads; (6) small operating cost per year.

Small Relay.—(1) Uniform intensity of illumination; (2) decreased outages; (3) can be installed in a small space; (4) require a very small operating current to open the contacts.

Approximate Formula for Voltage and Conductor Sizes

Simplified expression based upon Kelvin's law gives sufficient accuracy for most practical purposes

By E. A. Loew

Professor of Electrical Engineering University of Washington, Seattle, Wash.

THE fundamental consideration in the design of a transmission line is the law of economy known as Kelvin's law. When slightly modified, this law furnishes the basis for the following rule in transmission line economics: The voltage and the conductor size should be so chosen that the value of the energy annually wasted as line loss is equal to the annual interest and depreciation on all items of investment in line and equipment, whose costs are functions of either the conductor area or the line voltage.

Obviously, other additional factors will have to be given due consideration before a final choice of voltage and conductor size may be made. Among these, the following are important:

(a) Voltage standardization.
(b) Interconnection with existing lines.
(c) Regulation.
(d) Line capacity or load limit.
(e) Line stability.

Nevertheless, while these and other considerations are all of importance, the question of over-all economy is fundamental. The conclusions reached from a study of Kelvin's law as applied to a particular problem will be the basic criteria from which the completed design will finally be evolved. It is therefore very important that the engineer should have methods available by which correct conclusions pertaining to the question of conductor and voltage economy may be reached as easily and quickly as possible.

The problem of reducing the above-mentioned law to mathematical form has frequently been attempted. In 1925 F. K. Kirsten and the writer published the results [1, 2, 3] of their efforts in this respect, and included in the discussion a formula from which the conductor diameter and the voltage could be calculated for any assumed conditions of load and length of line. While this formula is theoretically correct and yields satisfactory results, it has the disadvantage that, before it can be intelligently applied to a given problem, a considerable study of the theory upon which it is based is required. It was for the purpose of overcoming this handicap that the writer undertook to develop a simplified expression, based upon the same theory, which would quickly yield results of sufficient accuracy for most practical cases. Such a formula is given by the following equation:

$$E = \frac{TP}{\left(R + \frac{S}{L}\right)\frac{1}{6}} \qquad (1)$$

In this equation

E = line-to-line voltage in kilovolts.

P = a function of the load to be transmitted (for values of P see Table I).

R, S, T are constants as given in Table II.

L = length of transmission line in hundreds of miles.

TABLE I—VALUES FOR P IN EQUATION (1)

R.M.S. Kw.	P	R.M.S. Kw.	P
10,000	21.5	60,000	39.2
15,000	24.6	65,000	40.2
20,000	27.2	70,000	41.2
25,000	29.3	75,000	42.2
30,000	31.1	80,000	43.1
35,000	32.7	85,000	44.0
40,000	34.2	90,000	44.8
45,000	35.6	95,000	45.6
50,000	36.9	100,000	46.5
55,000	38.0		

TABLE II—VALUES FOR R, S AND T IN EQUATION (1) AND FOR V IN EQUATION (2)

Kind of Conductor	R	S	T	V
Stranded copper	46,000	27,000	25.6	17.9
Stranded aluminum	28,000	24,000	28.1	15.8
Hollow copper	30,000	20,000	25.6	21.6
Hemp core copper	.....	.....	....	....

Once the line voltage is known, from equation (1), the most economical conductor area is found from equation (2) below, using the appropriate value of V from Table II. Thus,

$$\text{Circular mils} = VE^2. \qquad (2)$$

As a matter of fact, considerable differences in the values assigned to any particular variable will affect the computed results obtained only slightly. The one quantity whose value may differ considerably from the one assumed, depending upon locality, circumstances and the judgment of the engineer in charge, is the selling price of a kilowatt-hour of energy at the receiver end of the line. This quantity is designated by the symbol A. In equation (1) the value of A is assumed to be 4 mils per kilowatt-hour, and the results which the equation yields correspond to this value. If it be desired to compute the voltage for any other value of A, this may be done by multiplying the voltage as found from equation (1) by the correction factor of Table III.

TABLE III—MULTIPLYING FACTOR FOR VOLTAGE (E) AS GIVEN BY EQUATION (1) IF VALUE OTHER THAN 4 MILS PER KILOWATT-HOUR IS CHOSEN

Value of A in Mils	Correction Factor
1	0.79
2	0.89
	0.95
	1.00
	1.04
	1.07
	1.10

[1] "*Transmission Line Design*," by F. K. Kirsten and E. A. Loew. *Bulletin No. 32, University of Washington, Engineering Experimental Station.*

[2] "*Electrical Power Transmission*," by E. A. Loew. *McGraw-Hill Book Company.*

[3] "*Economy in Choice of Line Voltage and Conductor Sizes for Transmission Lines*," by E. A. Loew. *Journal A.I.E.E., August, 1928.*

Cable-Sheath Corrosion

Corrosion cannot be laid to any particular kind of duct material. Stresses set up in sheaths during handling of cable are very important. Concrete, dense and well cured, is not harmful to lead

By JOHN F. MURRAY
Murray Conduit Systems, New York

IN THE last few years some isolated cases of severe corrosion have occurred in underground lead-covered cables installed in conduits. These cases have been in several kinds of ducts. The lead sheath in an underground installation is subjected to a series of conditions that are not existent in the open air and that are favorable to corrosion of sheath. While lead is one of the most durable of metals when exposed to the atmosphere or when entirely submerged in hard water, it may disintegrate when subjected to the action of certain salts found in the soil, when in contact with certain vegetable acids from decaying wood, such as tannic acid, when partially submerged in water for long periods, or entirely submerged in soft water, or when subjected to electrolysis. In discussing this subject of the basic causes of corrosion it should be borne in mind that millions of feet of lead-covered cable have been in contact with various kinds of ducts for periods of years, and generally there has been no trouble due to corrosion.

Pitting and perforating of the lead envelope are not confined to cable resting in conduit made of any one of the commonly used materials. Quite the contrary, they occur in all kinds of conduits—in vitrified clay, in fiber tubes incased in concrete, in wood (pump log), in steel and in concrete. In analyzing the basic causes of corrosion it should be borne in mind also that long stretches of lead-sheathed cable have remained intact for protracted periods in conduits made of all the materials just mentioned.

Lead is a metalloid; it partakes of the nature of both a metal and a non-metal and its reactions depend upon its environment. It reacts with acids to form lead salts, the lead playing the positive part. At other times it plays the negative rôle and combines with strong bases to form plumbites and plumbates of sodium and calcium. This explains why lead is destructively corroded by both acetic and other weak organic acids found in some wood conduits, and by calcium hydroxide, which is present in green, unseasoned concrete.

STRUCTURE OF LEAD FAVORABLE TO CORROSION

The structure of lead is particularly favorable to corrosive attack, inasmuch as the metallic crystals are separated by extremely thin intercrystalline layers of impurities. During the process of corrosion these impurities are removed first by a selective attack that brings about intercrystalline brittleness and causes the lead to change into a granular powder. Intercrystalline brittleness is a function of the purity of the metal. Besides commercial lead, which always contains impurities, alloys of lead and antimony and lead and tin are used for cable sheaths.

Preliminary tests have shown that the tin lead and tin cadmium lead alloys have very close-grained structures and are highly resistant to corrosion. The lead-antimony alloy is the least durable; it corrodes most rapidly. At any rate, such fragmentary information as is available today shows clearly that the composition of the lead sheath unquestionably is one of the important factors in the corrosion equation. Research will eventually show which alloy is the least subject to corrosive attack and cable manufacturers will undoubtedly make use of it in the manufacture of sheaths subject to severe operating conditions.

Although lead is very susceptible to both basic and acidic corrosion, there will be no corrosion when moisture is absent. Water is the great stimulator of corrosion, especially when it is soft and free from carbon dioxide. This is a very important fact for all those engaged in the design, construction and maintenance of duct lines. Cables laid in dry ducts will never be corroded regardless of what the other conditions are or what compounds are present. The question that naturally presents itself is, Will it pay to keep the ducts dry? This, of course, will depend largely upon the terrain and the amount of trouble that is being had with sheath deterioration.

Evidence of local electrolysis
The raised island was probably cathodic and the corroded area anodic.

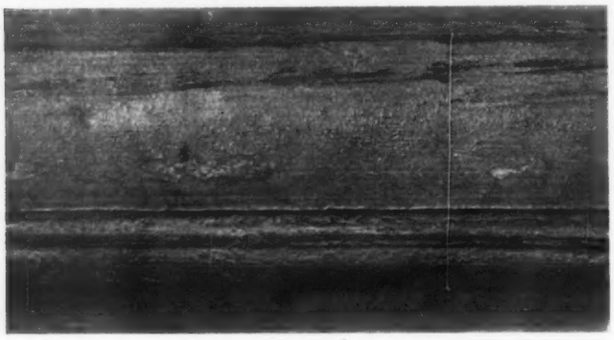
While it is impractical in a good many places to maintain the ducts free from water, it is possible to take steps in this direction by constructing less permeable conduits, by pitching ducts so that they will drain thoroughly and quickly and by draining or pumping manholes.

Ground waters containing appreciable quantities of carbonate or bicarbonate do not corrode lead perceptibly, owing to the formation of a protective coat over the areas which would otherwise become the seat of attack. Ordinary hard waters which contain the bicarbonates of calcium and magnesium, therefore, do not attack lead. Carbon dioxide in the water has the same protective effect. This explains the durability of lead-sheathed

cables when submerged in some waters. On the other hand, certain soft waters, especially those containing nitrites, dissolve lead. Rain water, water from swamp areas containing organic acids and even distilled water dissolve lead. Such waters are treated with calcium carbonate to make them unreactive with lead in the case of drinking water supply, so as to prevent lead poisoning.

Calcium Hydroxide Corrodes Lead

Whereas carbonates, bicarbonates and carbon dioxide in water inhibit the corrosion of lead, chlorides and nitrates increase it. Calcium hydroxide (ordinary slaked lime) also reacts with lead and will be discussed in greater detail because of its presence in green or unseasoned concrete. Thoroughly seasoned concrete contains no calcium hydrate and therefore has no harmful effect on lead. This is conclusively proved by the thousands of miles of lead-sheathed cable that are giving satisfactory service in concrete conduit.



Scoring facilitates corrosion

During the initial interaction of the cement and water in concrete which is seasoned there is formed a small quantity of calcium hydrate. The richer the mix the more hydrate there is formed. Calcium hydrate, however, is a very active compound. The moment any calcium hydroxide is exposed to the air in the presence of moisture carbonate is formed. Carbonation naturally begins at the surface of the concrete and works inward.

Under normal conditions of curing and with a mixture that has been properly designed and thoroughly compacted concrete conduit may be considered safe at 28 days. By this time all of the calcium hydroxide in the surface layer of concrete has been neutralized to form calcium carbonate.

It is essential to make the concrete dense and impermeable so that it will not allow the passage of water. Leaching action from the interior of the concrete must be avoided. Where the concrete has been cured long enough to convert all of the calcium hydrate throughout the entire wall thickness there is comparatively little danger connected with the passage of water. Neglect of thorough seasoning is largely responsible for whatever trouble has been had with concrete conduit.

Another important factor in the corrosion of lead is differential stress in the cable sheath. Areas that are subject to kinking, sharp bending or crushing will have a potential different from that of unstressed areas. The stressed parts of the sheath are anodic and are the seat of corrosive attack, which generally is of the pitting and perforating type. The unstressed areas are cathodic and are relatively free from any destructive action. A familiar example of corrosion induced by differential stress is that occurring at the bend of a crooked nail or at the edges of automobile fenders. It is very important therefore to avoid abusing the lead sheath while the cable is being drawn into the duct, so as to prevent the formation of stressed anodic areas.

Differential Aëration Favors Pitting of Sheath

Differential aëration may also play an important part in the corrosion of lead cable sheaths. Thus if part of the lead sheath has free access to air and another part close by is shielded from it by being covered with water there is formed an electrocouple. For this reason water line exposure of lead-sheathed cable is most undesirable. Pitting and perforation are almost sure to occur here if this condition is maintained for any length of time.

It is a common observation in corrosion tests that the places where the lead specimens come in contact with the walls or floor of the vessel in which they are placed suffer special corrosion, even if the vessel is an inert and non-conducting body such as glass or stone ware. Also, in the case of specimens that are hung up by threads or glass hooks, anodic areas are produced frequently where the thread or glass shield the metal from oxygen, with the result that corrosion tends to become concentrated at these points. This explains the pitting action that is found on the lower parts of some cable sections where they come in contact with the duct walls. Corrosion of this kind may occur in conduits made of any material. It is not confined to any one of those already mentioned.

Dents, scratches or digs in the sheath lead to a concentration of corrosion at these points, since oxygen usually penetrates with difficulty into the bottom of holes,

Conditions that Stimulate Corrosion

1. Corrosion of lead-sheathed cable is not confined to any one kind of conduit; it occurs in conduits made of all the materials commonly used for this purpose.

2. Dense concrete that has been properly seasoned is as safe a conduit material as there is available. Thorough seasoning normally is effected in twenty-eight days.

3. Cables kept in dry ducts never corrode. Absence of moisture automatically puts a stop to all corrosion.

4. Hard waters and carbon dioxide, under some conditions of exposure, inhibit the corrosion of lead cable sheaths.

5. Several common substances, such as soft waters, lime and weak organic acids, attack lead vigorously. The structure of lead is favorable to corrosion of the intergranular type.

6. Other features involved in the corrosion of lead cable sheaths are: Differential stress, differential aëration, scratched or abraded surface areas, and electrolysis. Electrolysis may be due to stray currents, to galvanic action, or to differences in the concentration of salt solutions in contact with the cable.

7. The grain structure of the lead sheaths is markedly affected by the extruding process.

8. A great deal of research remains to be done on the subject of corrosion to show how the various independent variables affect the rate of attack.

but has free access to the higher places. This explains the comparative immunity from corrosion of highly polished metallic surfaces and the greater susceptibility of rough ones. The ridges and valleys form a series of minute electrocouples. For this reason it is important to manufacture cable sheaths having smooth surfaces, free from any marks left by rough dies, or by improper temperature of the metal at the time of its extrusion. Care should also be taken not to scratch the sheath when the cables are introduced into the ducts. All too often the lead is scored and even deeply gouged at this time.

Electrolysis and Corrosion

Electrolysis due to stray currents from the negative returns of street railways and electrified railway systems is one of the most commonly known causes of lead sheath perforation. Inasmuch as the mechanism of this agency is comparatively well understood and more or less effectively combated by remedial measures, little need be said about it. Practically all of the power distributing companies keep a careful record of the cable sheath potentials and try to keep them negative at all times. Positive sheath potentials usually mean severe corrosion. Electrolysis or galvanic action also occurs when some other metal comes in contact with the lead sheath in the presence of water.

Electrolysis may be induced by other conditions. There are cases on record where tinned or galvanized copper jumpers, connecting cables for electrical drainage, have been folded in such a manner as to run alongside of the sheath, making contact with it at places other than the junction. This has resulted in galvanic action that ultimately pierced the sheath. Electromotive forces causing electrolysis are also generated by differences of concentration of solutions in contact with lead. For instance, sea water in one place and diluted sea water in another form

Intense corrosion in a confined area

a concentration cell that may lead to destructive corrosion of the lead sheath.

A review of both the scientific and industrial literature on the corrosion of lead sheath cables indicates the necessity of much more research work, for the purpose of mitigating the trouble experienced by the power distributing companies on their lines. The information available today plainly indicates that there are several ways of combating corrosion. It is quite evident that the conduit cannot be made to shoulder all the blame for the corrosion that has been puncturing the lead sheaths. Undoubtedly the cable manufacturers have an opportunity to lessen corrosive attack by instituting some basic research on the corrosive susceptibility of the various alloys of lead that offer themselves for sheath manufacture. Greater care may have to be taken in the composition of batches of lead that are charged into the melting pots of the extruding machines. The use of reclaimed lead contaminated with undesirable impurities is doubtful proce-

Scattered corrosion pits

dure, to say the least, and should not be allowed in the case of cable sheaths that are to be exposed to severely corrosive conditions. Even the process of extruding a cable sheath has a marked effect on the structure of the lead; the nature of the streamline flow in the formation of the sheath will affect its mechanical and chemical stability.

Transmission Factors of Colored Glass Accessories

By M. Luckiesh

Director Lighting Research Laboratory, National Lamp Works, Cleveland, Ohio

FOR many years we have co-operated with manufacturers in the development and standardization of colored glass accessories for use in the growing field of color lighting. Inasmuch as compromises between transmission and purity of color are necessary, standardization becomes largely a matter of judgment between production and use of colored light.

In general, colored glasses do not transmit light of a pure spectral character. For example, red, which is quite colorful, may be appreciably diluted with light other than spectral red without very noticeable loss of predominant red hue. Differences in transmission factor between glasses of the same color are largely due to differences in purity of the spectral color produced. Light of quite pure color is required for certain critical applications, but for many phases of color lighting more diluted colors are satisfactory. In fact, the latter are more practicable

Approximate Transmission Factors

Color	Moderate, Per Cent	Deep, Per Cent
Red	10 to 20	3 to 8
Yellow (amber)	50 to 65	30 to 40
*Green	10 to 16	3 to 8
Blue	3 to 5	0.5 to 1.5

*Most green glass accessories at present tend toward the blue-green. We favor a yellowish-green because it is more nearly a primary green, which has widest applications and gives most desirable results in mixtures of colored lights. For the same transmission factor a yellowish-green accessory gives a more saturated color than a bluish-green. Accessories of the color which we would recommend would have transmission factors of approximately 5 to 10 per cent for moderate and 3 to 5 per cent for the deep green color.

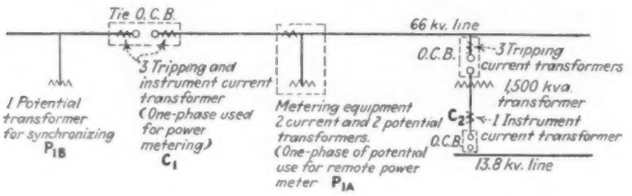
owing to the higher efficiency of this innately inefficient method of obtaining colored light. In the table on page 1297 are presented the transmission factors for both moderate and deep specimens of each color. The glasses termed "moderate" transmit somewhat diluted colored light, while those specimens of deeper color may be considered pure colors for exacting requirements.

Inasmuch as colored media change in color and transmission factor when heated, we always make such measurements after the glasses have been allowed to reach a stable temperature as they would in actual service.

Measuring Power Interchange

By Wellen H. Colburn
Electrical Engineer with the
Edison Electric Illuminating Company of Boston

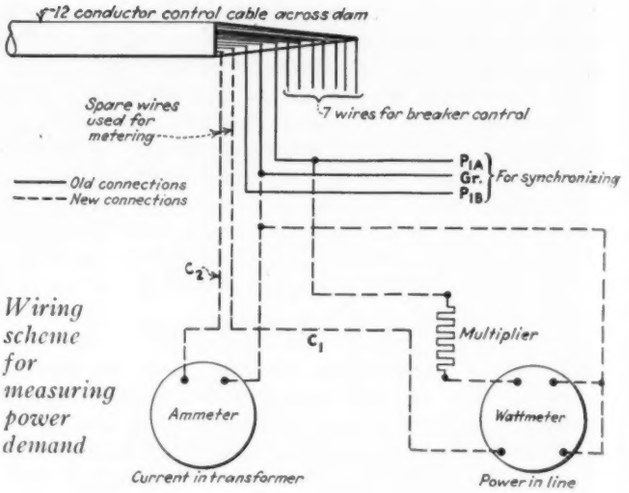
RECENTLY it became necessary to measure the power interchange between two utilities over a 66-kv. (three-wire, three-phase) tie line and the load current of a tie transformer between that line and the 14-kv. system of one of the companies. The required information was (1) three-phase power through the line tie breaker, the synchronizing point, and (2) current in one phase of the transformer. The control board was more than 1,000 ft. away across a reservoir dam. The one available duct in the dam was occupied by two lighting mains and a twelve-conductor cable which provided control for three oil circuit breakers, potential connections for synchronizing the line and two spare wires. As one spare wire was needed for the transformer current measurement, only one wire was left for the three-phase power measurement.



One-line diagram of 66-kv. tie line and transformer set-up

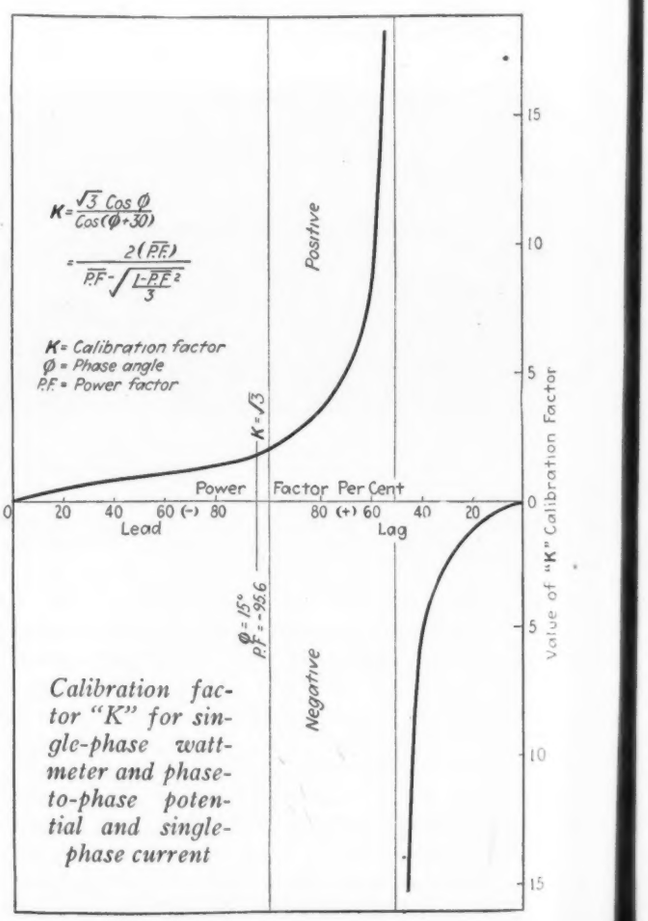
Since changing the cable or providing another duct was unjustifiably costly, the problem became that of reasonably accurate measurement of three-phase power with the one phase-to-phase potential already available for synchronizing and one phase current, having a 30-deg. displacement at unity power factor. The use of phase-to-phase potentials for synchronizing and the standards for grounding current transformer secondaries precluded combining either to eliminate the displacement angle.

Under such conditions, a single-phase wattmeter with suitable calibration can be used, but obviously will be correct only for balanced load at that power factor for which it is calibrated. The calibration factor, K, readily deduced by equating the actual power to that read by a single-phase meter, is shown for any power factor in the graph herewith. From the curves it is obvious that with power-factor variation such a meter's readings are worthless. However, a single-phase wattmeter scaled three times normal and connected on phase-to-neutral voltage and phase current will read three-phase power correctly, barring errors due to unbalance of phase voltages and currents.



Wiring scheme for measuring power demand

Since the conventional methods of shifting the voltage or current 30 deg. to simulate the phase-to-neutral voltage-phase current relation were precluded the only alternative was to provide a 30-deg. voltage shift in the instrument's voltage multiplier. The resistance of the multiplier and the reactance of the instrument voltage coil were so arranged that the desired phase relation between voltage and current elements existed. The scale was calibrated then three times normal. Allowing for inevitable errors due to phase unbalance, this scheme under such restricted conditions provides a reasonably satisfactory three-phase power measurement with a single-phase meter.



Calibration factor "K" for single-phase wattmeter and phase-to-phase potential and single-phase current

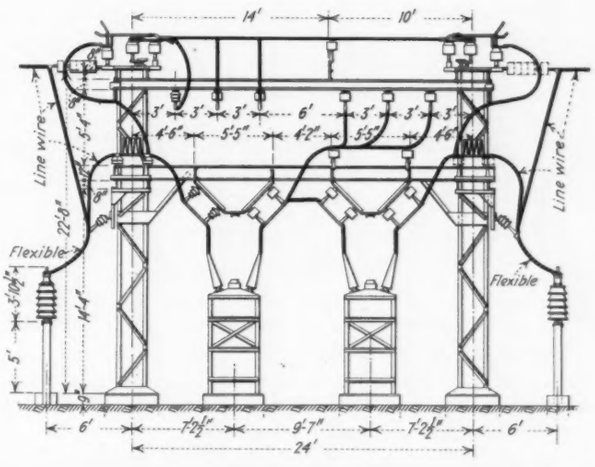
Economical Substation Design

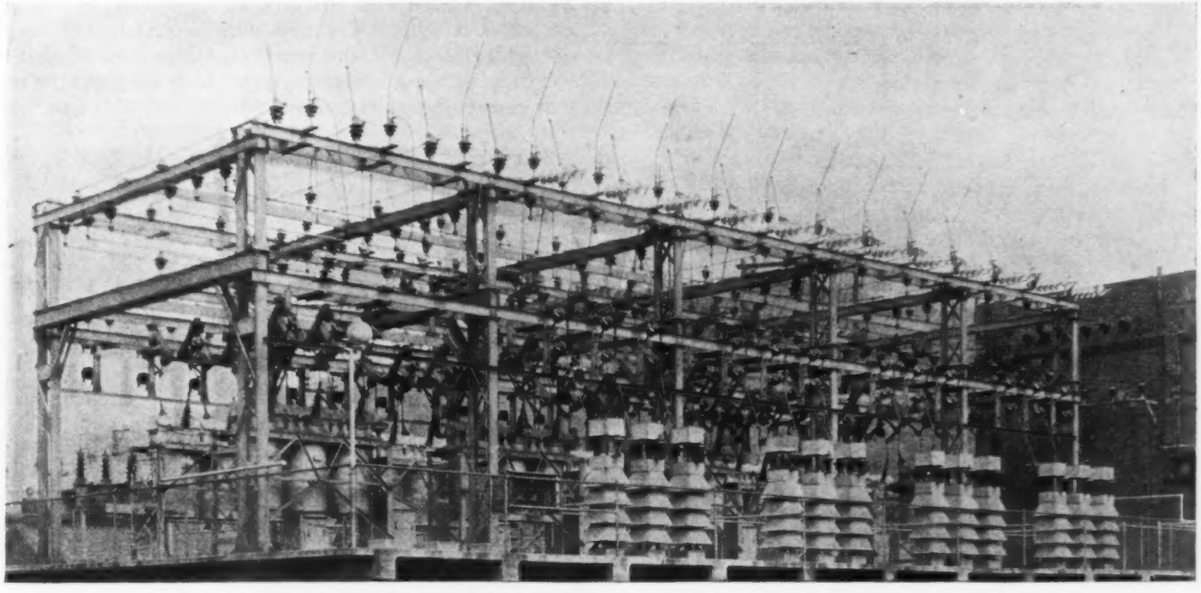
West Penn Power Company reduces number of pieces, weight of steel and over-all dimensions of outdoor bays and at the same time improves operating characteristics

By H. A. P. Langstaff
Relay Engineer West Penn Power Company, Pittsburgh, Pa.

THE West Penn Power Company has in the past few years transferred a number of its 25-kv. indoor controls to outdoor equipment, and from time to time improvements have been made in the methods used. The original standard substation bay has been superseded by a greatly simplified design which allows a saving of some 10 per cent in ground area per double bay, without sacrificing clearances, etc.

Perhaps the most startling change as a result of the new design was the reduction in the number of items of steel from 54 to 9. In turn, the number of pieces per double bay was reduced from 355 to 284, a reduction of 20 per cent without undue loss of strength or ruggedness. These reductions, of course, were the predominant factors in simplifying erection of the steel and reducing the possibility of error in assembly. To reduce the error possibility further, all of the necessary pieces are double





Substation bay formerly standard for outdoor construction

The old standard double bay layout for two line breakers. This shows the relatively close overhead clearance over the oil circuit breakers due to the disconnect mounting, also the horizontal arrangement of the main and reserve buses on the top strut.

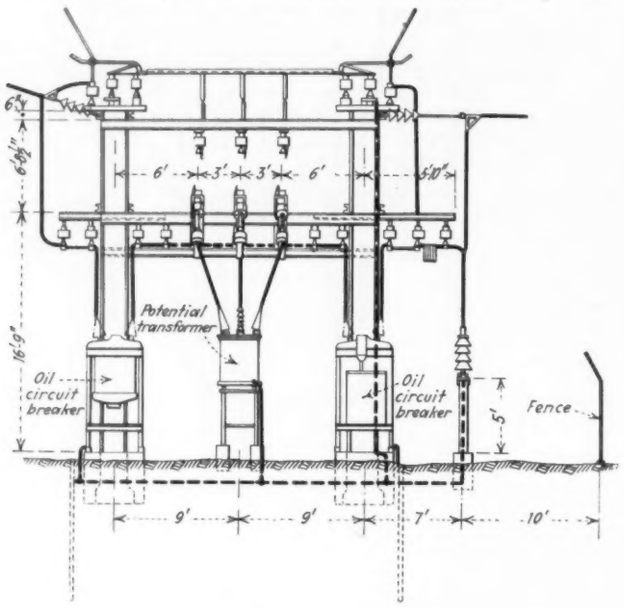
punched, which eliminates there being any right or left hand pieces. A number of unused holes in the steel is the result of this procedure, which, however, seems warranted due to the simplification effected. The weight of the steel was reduced approximately 22 per cent per double bay. This also allowed quite a saving in erection costs.

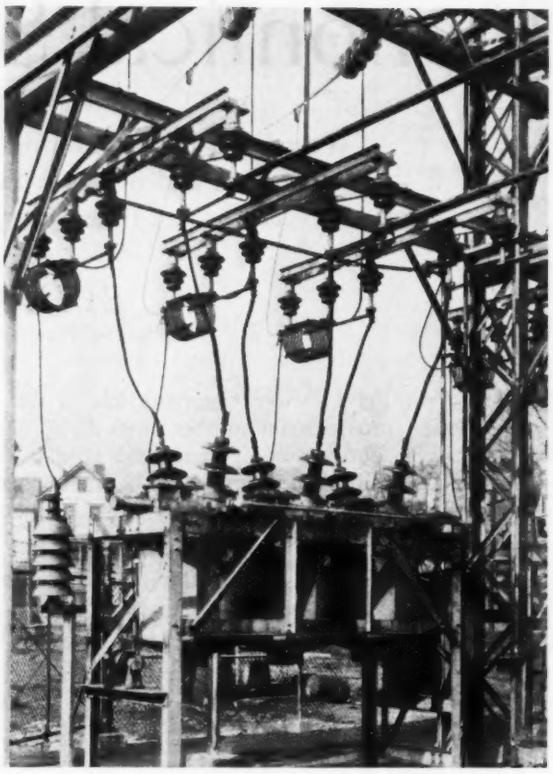
One of the chief objectives from an operating viewpoint was the use of unit type air-break switches with grounding switches on the same mounting and duel gang-operated disconnect switches with choke coil mounting on the line side of the line oil breakers. These features are incorporated in the new design in such a manner that the air-break switch, grounding switch and disconnect controls are mounted on the same column. The oil circuit breaker layout is such that the mechanism end of the

breaker faces the same column upon which the controls are mounted. This grouping of the controls expedites and simplifies the removal of a line from service to clear it for maintenance and repairs.

One questionable feature arose in connection with the air-break switch controls. This was due to the fact that in a bay requiring the mounting of two of them a short linkage is required for one, while the other requires a long linkage. The manufacturer promptly overcame what might have resulted in long, bothersome details when ordering a number of these switches by identifying the linkages by bill of material numbers. The procedure when ordering is merely to specify the number required under each bill of material number.

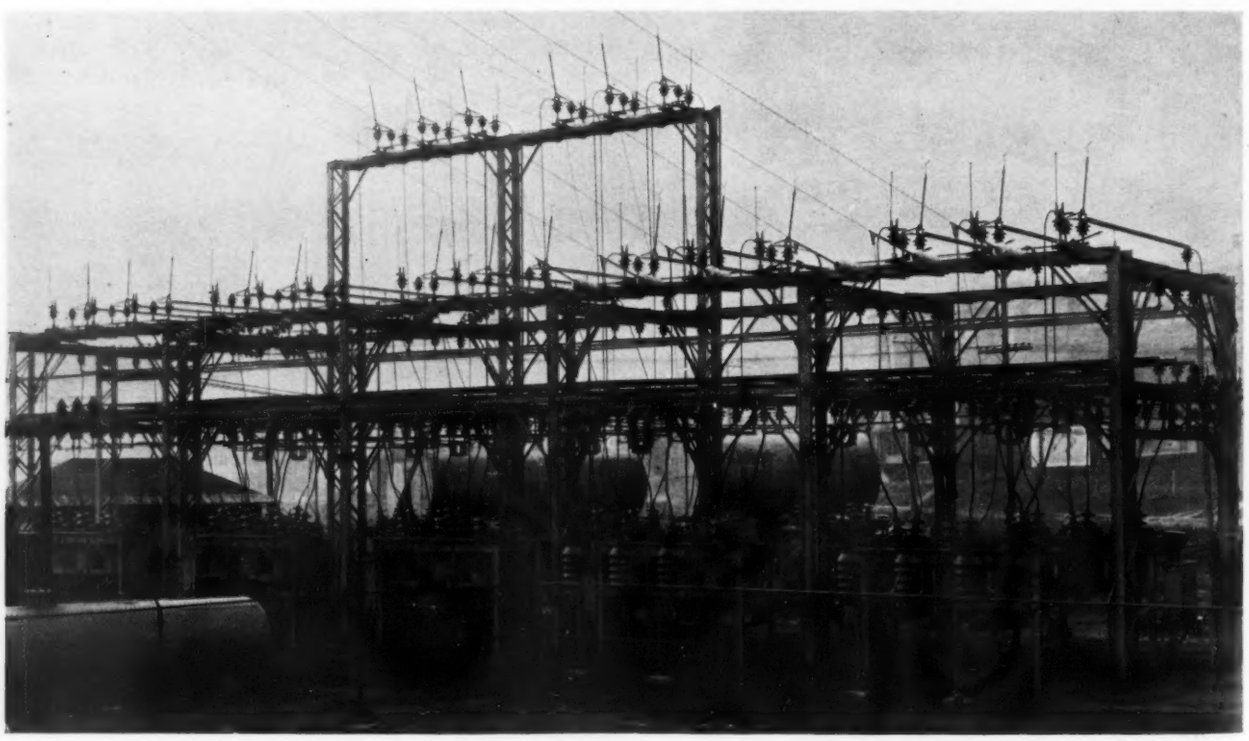
The dimensions of the old standard double bay were





Air-break switch, grounding switch and disconnect controls are mounted on same column

24 ft. x 16 ft. and correspondingly those of the new are 18 ft. x 19 ft. The new dimensions allowed the use of lighter steel for the struts, but also necessitated the use of larger and longer copper tubing for both the main and reserve buses. However, the added size and length



Simplification featured in new standard double bay design

This shows the main and reserve buses mounted perpendicularly on the lower and upper struts. This also shows the oil circuit breakers in line with the upright columns and the bus potential transformer, which is mounted at one end of the structure, thus leaving a very trim appearance looking down the mid-section of the completed structure.

of the new bus tubing was more than offset by the elimination of seventeen rather expensive interchangeable insulator units. The elimination of those units was made possible due to the use of the combination air-break and grounding switch and the choke coil mounting being made on the same base as the line side of the gang-operated disconnects. These combination units are more expensive than the similar equipment in the old standard, but the total cost of material of a complete new standard double bay is only a small percentage greater than the cost of the old. It is felt that this small percentage is more than overcome by the reduced cost of assembly.

All of the new features were successfully incorporated without disturbing or altering the standard clearance between phases and from phase to ground. All of the bus work is perfectly straight, there being no intricate geometrical curves and turns as in the old bus layout. The rugged simplicity and comparative compactness of the new structure makes it adaptable to general use, no matter how large or small new station requirements may be. Ease of assembly and operation have been obtained, but not at the expense of economy. All things considered, the new standard is so vastly superior to the old that hardly a comparable advantage has been lost in the changed design.

Energy Consumption of Street-Lighting Installation

By J. A. Cook*

Superintendent Electrical Department, Lynn (Mass.) Gas & Electric Company

FROM tests of a variety of series street-lighting units supplied from the distribution system of the Lynn Gas & Electric Company the following tabulation of energy consumption has been prepared on account of the interest of operating engineers in over-all system performance. The lamps are series incandescents supplied from General Electric type "RO" constant-current transformers located on poles at various points in the city and connected to the 4,000/2,300-volt distribution system. A standard transformer size of 20 kw. has been adopted and each transformer with its control switch is mounted on a single pole. The input to the primaries of these transformers is computed and added to the input of the 4,000/2,300-volt street-lighting bus in the station, which supplies a number of constant-current series circuits of both alternating-current and direct-current type. A watt-hour meter is installed in the station to meter the street-lighting bus. Metering the energy input to the type "RO" transformers, which are located on poles scattered through the territory, is a difficult and expensive task involving instrument, current and potential transformers and outdoor metering equipment for each type "RO" transformer. These kilowatt-hours are not used directly in billing, since investment, operating, energy and maintenance charges are all included in a flat rate per lamp as billed to the city.

A series of tests was made for each size of street lamp used extensively in the territory and advantage taken of the fact that each type "RO" transformer is loaded to about 90 per cent of its rated capacity. The tests were continued over at least one month and the average watts input to the type "RO" transformer was computed per lamp supplied. These figures differ from the manufacturer's rated lamp consumption since they include that proportion of the "RO" transformer losses and series circuit line losses chargeable to one lamp. From the results of these tests estimates were made of the corresponding consumption of street lamps, of which only a few are used. The results of the tests and estimates are shown in the accompanying table, together with the source of the information whether test or estimate. Data are included for other types of lamps.

The station log shows the number of hours each street-lighting circuit is energized daily. The "RO" transformer control switches are energized by solenoids connected to series lighting circuits which terminate at the station and which are turned on by the station operator. Accordingly, all street lamps, including those supplied by the "RO" transformers, are switched on and off from the station and the monthly hours of burning can be computed from the station operating log sheets.

From the figures for the number of street lamps of each size connected to "RO" transformers, the figures of lamp consumption in the table and the monthly hours that street lamps are energized, the monthly energy input to type "RO" transformers may be computed.

A record is kept of street lamp locations by municipalities served and the figures in the table are used to allocate the kilowatt-hours for street lighting to the several municipalities.

Most of the energy used on this system is metered at the busbars. The energy loss between the station and the primaries of type "RO" transformers is small, particularly as during most of the hours of street lighting the current carried by the commercial feeders which supply the type "RO" transformers is small. For the Lynn system the losses beyond the switchboard to the meters and transformer primaries are in total less than 1 per cent.

Energy Consumption of Various Types of Lamps

Type of Lamp	Type of Mounting	Street Lighting Circuit Originated at	—Manufacturer's Rating— Lumens	Amperes	Watts at Lamp	Watts Supplied at 2,300 Volts to Primary of Street Lighting Transformer per Lamp on Circuit	No. of Lamps	Basis of Figures
Mazda "C"	Street system bracket type "Novalux" units	Constant current transformer in station	600	5.5	41.1	54	513	Test
Mazda "C"	Residential type "Novalux" units	Type "RO" transformer on pole	2,500	5.5	147.0	193	...	Computation
Mazda "C"	Highway type "Novalux" units	Type "RO" transformer on pole	2,500	6.6	152.4	209	109	Test
Mazda "C"	Semi-ornamental type "Novalux" units	Type "RO" transformer on pole	4,000	15.0	228.6	284	...	Computation
Mazda "C"	Semi-ornamental type "Novalux" units	Type "RO" transformer on pole	6,000	20.0	310.9	418	43	Test
Mazda "C"	Semi-ornamental type and bracket type "Novalux" units	Type "RO" transformer on pole	10,000	20.0	518.0	643	27½*	Test
Mazda "C"	Ornamental type "Novalux" units	Type "RO" transformer on pole	15,000	20.0	750.0	978	18	Test
Luminous arc lamp	Pendent type	Rectifier set in station	.....	4.0	320.0	399	45	Test
Luminous arc lamp	Ornamental type	Rectifier set in station	.....	6.6	528.0	595	72	Test

*Average of four tests.

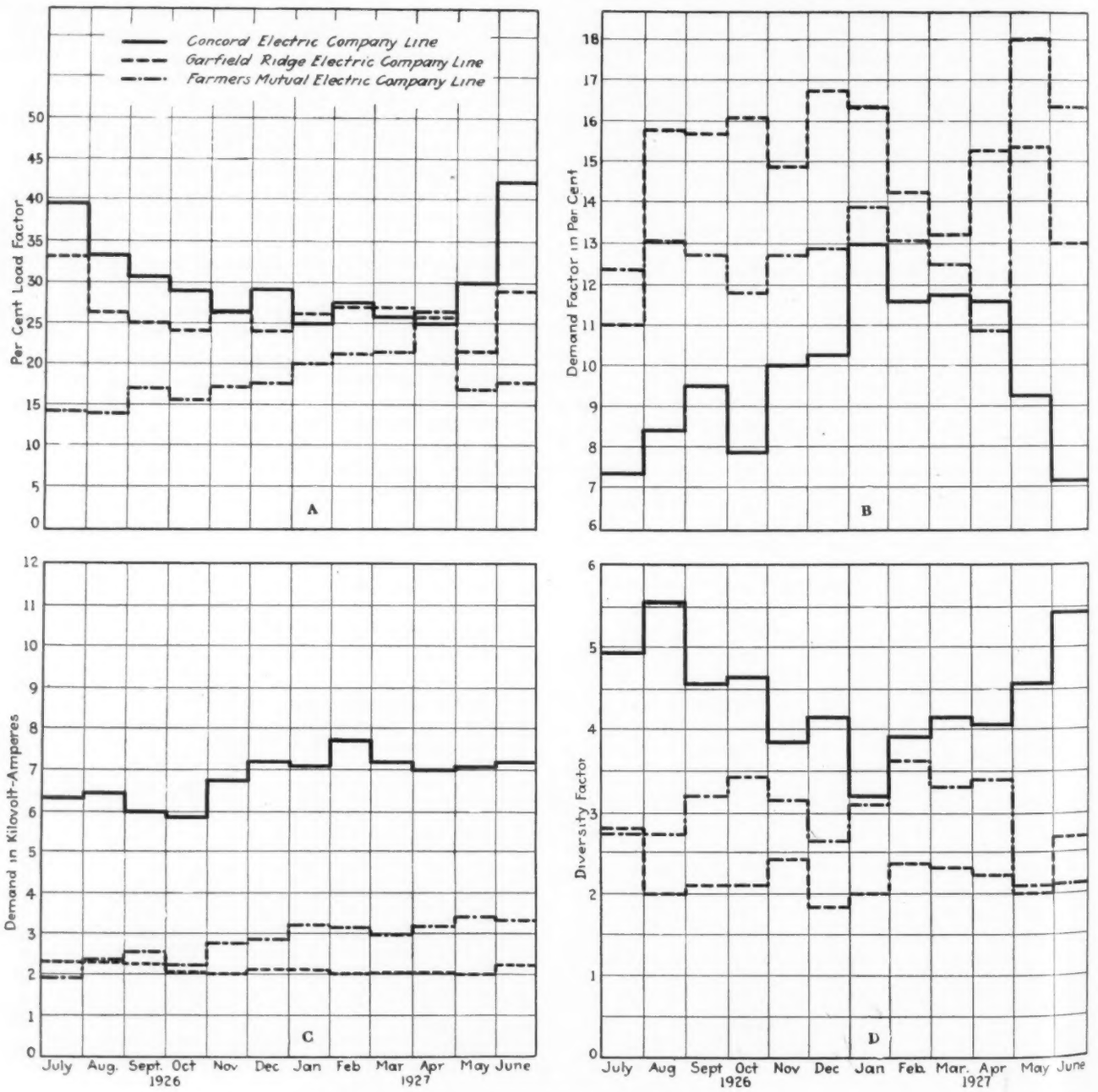
Electric Heating Installation for London Building

A LOW-TEMPERATURE electric heating installation has recently been completed for a four-story building with a total volume of 175,000 cu.ft., located in London, England. The cost for electric heating was estimated at approximately $1,200 per year, against approximately $830 a year for coke heating, the latter, of course, requiring attendance. These figures are based on a heating season of 900 hours.

The system, which is designed to maintain a temperature of at least 60 deg. F. in the rooms and on the landings when the external temperature is 32 deg. F. with 2½ changes of air per hour, employs resistance heaters inclosed by welded steel containers about 2 in. in diameter and varying in length from 5 ft. to 16 ft. In the entire building there are 142 tubes totaling about 1,815 ft. in length. The total load is 116 kw., or about 60 watts per foot. The supply system is three phase, 400 volts, 50 cycles.

Rural-Line Characteristics

THE four charts shown are reproduced from "Official Publication" No. 9, Vol. XXVII, of Iowa State College, entitled "Electric Service for the Iowa Farm." This pamphlet details a study of characteristics of three lines which serve the Iowa rural electrification project at Garner. The Concord line, which shows up the best in the charts in regard to demand, diversity and load factors, serves seven of the eleven co-operator farmers in the project and graphically illustrates the benefits of farm electric equipment. It has also the highest consumer density per mile, 1.77, while the Farmers Mutual and Garfield Ridge have 1.33 and 1.52, respectively.



Service factors for rural lines as found in Iowa

The monthly values for (A) load factor, (B) demand factor, (C) demand in kva., and (D) diversity factor for lines serving farm territory have been charted

Railroad Electrification

As Seen from Baltimore Angle

Effect it would have on local load and particularly load factor if power were purchased. Obsolescence in private plants. Considerations in contracts

An Interview with
HERBERT A. WAGNER
President Consolidated Gas, Electric Light & Power Company of Baltimore

AS THE Pennsylvania Railroad has been reported* to be considering plans for increasing its tunnel and terminal facilities in Baltimore, which will require complete electrification of its lines in that locality and eventually an extension from Wilmington to Washington of its New York-Wilmington electrification now authorized, it is possible that the Consolidated Gas, Electric Light & Power Company of Baltimore may be called upon to furnish power. With this possibility in view Herbert A. Wagner, president of the Baltimore company, was interviewed to ascertain the significance he attaches to the electrification of the Pennsylvania Railroad from a local and national viewpoint and also what principles he considers fundamental to any agreements for supplying power. Mr. Wagner's comments follow:

H. A. Wagner

"While negotiations were started some time ago, we have as yet made no contract for the supply of electric power to the Pennsylvania Railroad, although we hope to make such a contract covering its operations between Wilmington and Washington. Surveys have been made as to the possibilities of supply and substation locations, but no rates have been presented, even for discussion.

"In the event that a contract should be consummated, the Pennsylvania Railroad would not become our largest single consumer of power, nor would it materially affect the general character of our load or our service to existing customers. The effect on our over-all load factor would probably not be appreciable, but such effect as there might be would tend to reduce the average load factor.

"Nevertheless, it is an established fact that increased power consumption of any kind, except for loads of unusually poor load factor, has a marked tendency to reduce the cost of production. This is brought about in two ways: First, by requiring extensions to generating plants with the adoption of improved and more efficient equipment, and, second, by an increase in the size of generating units, resulting in higher efficiency and lower labor costs. The Pennsylvania Railroad load, if obtained, would exceed our existing supply to railroads, including the street railway system.

"In general, the load factors of steam railroads are low, but with electrification there would no doubt be a marked improvement. This would be brought about by the economic necessity of keeping down the investment in generating station, transmission, substation and distribution equipment. This can be effected by a rearrangement of freight movement schedules to keep freight movement at a minimum at times of passenger traffic peaks, together with the possibilities of speeding up the movement of freight.

"Under today's conditions, and surely for many years to come, the demand for power in our large cities will increase far more rapidly than the power required for operating existing railroads in the same or nearby territory. The effect of this rapidly growing power demand is to enable utilities to take advantage of the latest improvements in electric power plant equipment and to keep more extensively in use the most modern type. On the other hand, a power plant put in for a railroad electrification today might be nearly obsolete ten years hence, or would undoubtedly be far less efficient than equipment that would be available at that future time.

"From the viewpoint of the public, electrification of steam railroads, where traffic is dense, will greatly increase the carrying capacity of existing lines and trackage, which could only be accomplished with steam by increasing the parallel trackage. The general public would be benefited, particularly as to suburban traffic, by more rapid and more frequent transportation."

CONTRACTUAL RELATIONS

Although no agreement has been made between the Pennsylvania Railroad and the Consolidated Gas, Electric Light & Power Company for supply of power for the railroad electrification, Mr. Wagner's opinion was sought on the underlying principles which should prevail in such a contract were one consummated. He said:

"Any contract made by a utility for supplying railroad

*See ELECTRICAL WORLD, *March 3, 1928, page 874.*

power would undoubtedly provide, or automatically carry with it, reductions in the rate as reductions might be made in general power rates or in the cost of production. In other words, the contract should provide that in any event the railroad rates should be as low at all times as the rate made to any power consumer under like conditions. Even were this not a provision of the contract, it would probably obtain under the usual Public Service Commission regulation.

"Taking all these facts into consideration, it could be said with conviction that the cost of power for railroad electrification will on the average be considerably lower if this power is produced by a large utility than if it is produced by the railroad itself. The difference between these two costs should be more than sufficient to produce a fair profit to the utility. The economic possibilities of combined or centralized power production and a fair division of the benefits of such combined production should influence the railroads to purchase power in almost every instance with benefit to the railroads, public utilities and general public. The Pennsylvania Railroad seems to be one of the great railroad companies which understands and appreciates these economic considerations."

Electricity Supply Costs

Comparisons of costs in large and small systems in Wisconsin, by not being comprehensive enough to justify definite general conclusions, apparently indicate a misconception of the economies in far-flung operating systems

THE contention that the spread between electricity costs of small and large systems is not so great as wholly to justify the generally accepted idea that marked relative economy is a natural attribute of the large system is made in a recently published report from the National Association of Railroad and Utilities Commissioners. This report, which is the work of the special committee on generation and distribution of electric power, was presented at the convention of the association in New Orleans, Nov. 13–16, this year.

Quoting from the report, the problem which the committee set out to study is stated in the following manner:

"The growth of super-power systems in the last several years has been explained to be largely a result of economies attained through interconnection of many distributing systems and concentration of generation in large central stations. It is a commonly accepted view that the independent small generating and distributing system is destined to disappear because of its relatively high costs. Your committee on electric power has felt it desirable to have some quantitative data on unit costs which would indicate approximately the relative advantages of large and small systems. The present study is an endeavor to give statistical support to what is substantial in the argument for super-power and point out possible limitations of that argument. Using such material as public utility corporations have submitted to public utility commissions, we have computed unit costs for four types of electric systems for the years 1912, 1917, 1922 and 1927. These costs relate to large and small systems generating primarily by steam power and to large and small systems generating primarily by water power. They should indicate the relative advantage of large- and small-scale operations at the present time and show any changes taking place in the relative situation of large and small plants over the fifteen-year period. It is important to know whether the competitive situation of small plants is becoming relatively better or worse.

"To meet the requirement of the problem, it was necessary to study systems which were, as nearly as possible, self-contained and independent, generating all the energy they distributed and distributing all they generated. Each of the following four types of systems had to be considered: (1) A small system generating primarily by steam power. (2) A large system generating primarily by steam power. (3) A small system generating primarily by water power. (4) A large system generating primarily by water power.

"Since systems approaching medium size would probably combine characteristics of both large and small systems and thus obscure the indications of the data, we planned to choose systems within a range of 500,000 to 2,500,000 kw.-hr. annual output as representative of the small systems and those with outputs above 25,000,000 kw.-hr. for large ones.

"Besides being complete units, the systems chosen were to have been reasonably modern in 1912 as to methods and equipment and to have progressed to keep up to date throughout the period. In addition, the records were to have been complete and accurate enough to give a true story of the system."

System Records Studied

The study was originally planned to cover one each of the four typical systems in nine different states. But data were received from only two states, Wisconsin and Washington. Since the information from the latter state covered only one system—the Washington Water Power Company—the Washington data could be related to the study only in a substantive manner and could not be included in the directly comparative analysis. The study, then, is concerned only with systems in Wisconsin, three of steam and two of hydro generation, five in all, instead of only four as originally contemplated. The reason for the increase was that the system first chosen as typifying a small steam system, Richland Center, a municipal operation, was discovered to have undergone in its history "peculiar conditions of management" which "had caused the costs to vary greatly from the trend shown by other systems." Another steam system, Manitowoc, also a municipal operation, was therefore selected as being more in line, although its size was such as to lift it quite definitely from the classification "a small system generating primarily by steam power." The third steam system considered in the analysis is the Milwaukee Electric Railway & Light Company. The small water power

Table I—Costs in Steam Power Systems

(From Report of National Association of Railroad and Utilities Commissioners)

	Richland Center				Manitowoc				Milwaukee			
	1912	1917	1922	1927	1912	1917	1922	1927	1912	1917	1922	1927
Kilowatt-hours generated, thousands	273	499	799	1,272	1,141	1,729	4,146	8,018	98,384	191,627	395,963	727,985
Capacity in kilowatts	275	462	850	850	810	1,050	2,550	4,250	76,650	98,085	175,700	264,700
Kilowatt-hours generated per kilowatt capacity	994	1,080	940	1,496	1,410	1,646	1,624	1,886	1,289	1,954	2,254	2,750
Superintendence and labor	0.640	.....	0.652	0.443	0.557	0.330	0.167	0.198	0.111	0.088	0.102	0.055
Fuel	1.437	.....	3.239	1.900	1.153	1.880	1.080	0.691	0.474	0.668	0.551	0.300
Water	.....	.....	.....	0.039	.....	.....	.....	0.001	0.006	0.003	0.001	.....
Water for power	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Miscellaneous supplies and expenses	0.091	.....	0.289	0.124	0.134	0.032	0.018	0.011	0.016	0.014	0.015	0.009
Total operation	2.168	†3.972	4.180	2.506	1.847	2.242	1.265	0.901	0.607	0.773	0.669	0.364
Total maintenance	0.127	†0.179	0.141	0.170	0.136	0.131	0.098	0.083	0.058	0.087	0.069	0.038
Total generation expense	2.295	4.151	4.321	2.676	1.983	2.373	1.363	0.984	0.665	0.860	0.738	0.402
Conversion and storage	.....	.....	.....	.....	.....	.....	.....	.....	0.036	0.035	0.037	0.035
Transmission	.....	.....	.....	.....	.....	.....	.....	.....	0.001	0.007	0.006	0.009
Cost to distribution system	2.295	4.151	4.321	2.676	1.983	2.373	1.363	0.984	0.702	0.902	0.781	0.446
Distribution	0.994	0.708	0.415	0.210	0.250	0.187	0.403	0.095	0.175	0.161	0.171	0.125
Cost of energy distributed	3.289	4.859	4.736	2.886	2.233	2.560	1.766	1.079	0.877	1.063	0.952	0.571
Utilization	0.109	0.163	0.018	0.081	0.346	0.160	0.070	0.043	0.292	0.128	0.069	0.082
Commercial	.....	0.032	0.120	0.114	0.171	0.207	0.066	0.081	0.053	0.066	0.084	0.089
New business	.....	.....	.....	.....	0.027	0.180	0.001	0.022	0.216	0.113	0.075	0.047
General and miscellaneous	0.413	0.104	0.487	0.399	0.622	0.188	0.258	0.154	0.182	0.139	0.168	0.091
Total expense before fixed charges	3.811	5.158	5.361	3.480	3.399	3.295	2.161	1.379	1.620	1.509	1.348	0.880
Taxes	*0.132	†0.100	0.309	0.270	0.169	*0.145	0.138	0.182	0.092	0.101	0.183	0.269
Total expense before depreciation and interest	3.943	5.258	5.670	3.750	3.568	3.440	2.299	1.561	1.712	1.610	1.531	1.149
Depreciation	0.461	0.350	0.529	0.511	0.537	0.506	0.315	0.344	0.334	0.261	0.291	0.245
Interest	0.658	0.500	0.756	0.590	0.767	0.722	0.450	0.491	0.477	0.371	0.416	0.349
Grand total cost per kilowatt-hour	5.062	6.108	6.955	4.851	4.872	4.668	3.064	2.396	2.523	2.242	2.238	1.743

*Estimated. †Approximate.

system chosen was the municipal one of Stoughton and the large one the Wisconsin Valley Electric Company. The data were compiled from reports to the Railroad Commission of Wisconsin and from information furnished by the systems themselves.

Compilation of Data

"When the data had been gathered the expenses for each system were reduced to a cost per unit for each class of expense. The unit used was the kilowatt-hour. Since the object of reducing expenses to unit cost is to secure comparability, it is necessary that the number of units to which a given item of expense applies be determined carefully and the expense item distributed only over this number of units. The difference in the proportions of total output which are secured and disposed of in like ways by the various systems made it desirable to consider each group of expenses by itself and find the unit cost in each group by dividing the expense by the number of kilowatt-hours to which that expense was directly applicable. The application of this policy resulted in the use of three different classifications of output for bases in computing unit costs. The effect is that the unit cost in each group is stated accurately, but a total derived by adding the group unit costs is not composed of exactly like parts and requires a little analysis before being used in any close calculations. Since the chief purpose of finding unit costs was to trace differences to particular steps in the producing and distributing process, the varying bases were adopted for use, in spite of the minor weakness in the totals secured by this method.

"Each group of expenses was divided by the portion of output to which such expenses seemed most accurately to apply. Generation expense, obviously, applied

Table II—Costs in Water Power Systems

(From Report of National Association of Railroad and Utilities Commissioners)

	Stoughton				Wisconsin Valley Electric Company			
	1912	1917	1922	1927	1912	1917	1922	1927
Kilowatt-hours generated, thousands	384	1,027	2,391	2,158	5,362	13,568	26,549	45,828
Capacity in kilowatts	310	520	520	520	1,800	2,890	6,712	12,552
Kilowatt-hours generated per kilowatt capacity	1,237	1,975	4,598	4,150	2,979	4,786	3,956	3,651
Superintendence and labor	0.561	0.468	0.317	0.342	0.124	0.098	0.109	0.069
Fuel	.....	.....	.....	.....	.....	.....	.....	.....
Water	.....	.....	.....	.....	.....	.....	.....	.....
Water for power	.....	.....	.....	.....	0.018	0.031	0.030	0.031
Miscellaneous supplies and expenses	0.109	0.040	0.027	0.028	0.017	0.011	0.013	0.007
Total operation	0.670	0.508	0.344	0.370	0.159	0.140	0.152	0.107
Total maintenance	0.051	0.020	0.123	0.137	0.090	0.053	0.043	0.013
Total generation expense	0.721	0.528	0.467	0.507	0.249	0.193	0.195	0.120
Conversion and storage	0.031	0.018	0.002	0.001	.....	.....	0.018	0.014
Transmission	0.001	0.004	0.019	0.002	0.001	0.006	0.012	0.027
Cost to distribution system	0.753	0.550	0.488	0.510	0.250	0.199	0.225	0.161
Distribution	0.202	0.312	0.197	0.147	0.144	0.106	0.151	0.129
Cost of energy distributed	0.959	0.862	0.685	0.657	0.394	0.305	0.376	0.290
Utilization	0.076	0.142	0.041	0.025	0.050	0.032	0.021	0.028
Commercial	0.166	0.081	0.091	0.104	0.061	0.022	0.077	0.110
New business	.....	0.030	0.003	0.000	0.198	0.116	0.006	0.055
General and miscellaneous	0.584	0.198	0.270	0.319	0.365	0.272	0.340	0.357
Total expense before fixed charges	1.785	1.313	1.090	1.105	1.068	0.747	0.820	0.840
Taxes	0.236	0.166	0.079	0.162	0.103	0.142	0.312	0.293
Total expense before depreciation and interest	2.021	1.479	1.169	1.267	1.171	0.889	1.132	1.133
Depreciation	0.589	0.414	0.207	0.262	0.212	0.313	0.303	0.282
Interest	1.179	0.827	0.414	0.524	0.425	0.625	0.605	0.565
Grand total cost per kilowatt-hour	3.789	2.720	1.790	2.053	1.808	1.827	2.040	1.980

to all energy generated by the plants or systems in which the expense was incurred, and so was divided by the total number of kilowatt-hours generated. Certain other expenses seemed more applicable to each unit of energy handled, no matter what its source, so conversion and storage expense, transmission expense, taxes, depreciation and the allowance for interest on return on fixed capital were divided by the total number of kilowatt-hours generated and purchased. The precise applicability of the base to the first two items might be argued, but the scheme adopted avoids introducing a needless complexity for the sake of small items and has more than a little claim to be used for other reasons as well. This change will not affect those systems that purchased no current.

"Some systems sell a large portion of their energy to other utilities, and such energy does not pass through the distributing system of the seller and involves little office expense in handling it. For this reason, distribution, utilization, commercial, new-business and general and miscellaneous expense were divided by the number of kilowatt-hours sold, less the sales to other utilities."

Local Conditions Important

It is not possible, in such a brief abstract and discussion of the report as is here presented, to include the large amount of qualifying and explanatory information that applies to the data in the tables reproduced. Suffice it to say that questions and exceptions that arise from a study of the tables are treated at length in the report. However, there is nothing said in explanation or qualification that can be accepted as indicating that the tabulated data can have more than their easily apparent worth, the small general worth that always attaches to figures developed by assumptive methods from single cases only.

The two tables shown here are composed of figures which are set forth in four tables in the report. The figures are in no wise changed, the only object being to save space. In these tables may be seen the evidence on which is based the argument on relative costs of small and large systems. This evidence is not so easily derived from the comparison of steam power systems as it is from that of hydro power. Taking the total generation expenses of Manitowoc and Milwaukee for 1927, one finds a difference of 0.532 cent in favor of the larger system; the difference between the two for grand total cost per kilowatt-hour is 0.653 cent. These differences indicate that nearly 90 per cent of the better performance of the larger system lies in generation and gives color to the statement in the report that "a small distributing system can be operated at a cost comparing favorably with that of a large one." The 1927 figures for generation expense in water power systems show a larger proportionate, but smaller actual, difference than do the steam systems. But this difference diminishes when the figures of total cost are taken, showing that the larger water power system has higher costs after the energy is generated than does the smaller.

There is included in the report another table of generation costs on nine individual steam stations for 1927, by which it is shown that plants with annual outputs of 8,000,000 and 10,000,000 kw.-hr. compare favorably in cost per unit of output with one of 22,000,000. The qualifying considerations which must be included in reasoning from this table are such, however, as to come seriously near to rendering a complete invalidation of any such conclusion.

Utility Sets Example in Electrical Advertising

Power plants and office buildings make ideal sites for illuminated display advertising. Valuable stimulant to sale of electric signs

By Charles Gallo

Lighting Department, Public Service Electric & Gas Company, Newark, N. J.

GOOD electric signs are valuable and economical advertising mediums that tie up with other types of advertising, and in many cases act as the focus or catalyzer of all advertising, since they may be displayed as reminders, at the most effective place, the place where the sale is actually made; that is, at the store, bank, filling station, shop or theater. The electric sign can work for the advertiser day and night, making a constantly repeated impression that cannot but help promote the "will to buy."

From a central-station viewpoint the electric sign is a very desirable revenue producer and one whose sales should be promoted by active co-operation. *Similia similibus curantur;* it follows that a good way for a central-station company to promote the use of electric signs is to use them on its own property. Public Service of New Jersey is doing exactly that, as one means of promoting electrical advertising business.

In 1927 a survey was made of all company buildings throughout the state to determine those offering suitable locations for signs. At that time there were already installed about forty signs on the various properties. As a result of the 1927 survey an appropriation of $328,-327 was made for signs and floodlighting during 1928. Of this amount, $53,622 was for floodlighting and $274,705 for electric signs. Most of the floodlighting has been installed, and the installation of electric signs is proceeding as per schedule. It is expected that by the end of 1928 practically all of the signs will have been erected. To date about 80 per cent of the signs have been erected or are purchased and in process of erection.

Traveling Cage Aids in Servicing

Among the larger signs which have been installed is one erected on the Terminal Office Building at Newark. This sign is 250 ft. long and reads "Public Service." The letters are 22 ft. high and have a stroke 4 ft. wide. The sign contains 790 sockets, spaced on 9-in. centers, and the circuits are wired to permit the use of lamps up to 75 watts in size at all sockets. At present the sign is equipped with 25-watt lamps. The steel frame for the sign is 253 ft. long and 30 ft. high. A bridge 53 ft. long had to be erected to carry the sign structure across the gap between the wings of the building. At the front of the sign there has been erected an inclosed cage which moves up and down in a structural steel traveler. This traveler is hung on a trolley, permitting it to be shifted along the entire length of the sign. By this method any portion of the sign may be safely and quickly reached without the use of a ladder. The structural steel supports of the sign weigh 43 tons and are anchored to the main steel frame of the building in order better to withstand the wind pressure to which they may be subjected. The sign is legible at night for a distance of 19,000 ft.

Another large sign has been erected on the Kearny power station. This sign is 211 ft. long and has letters

Night and day views of 250-ft. electric sign on Public Service Terminal Building

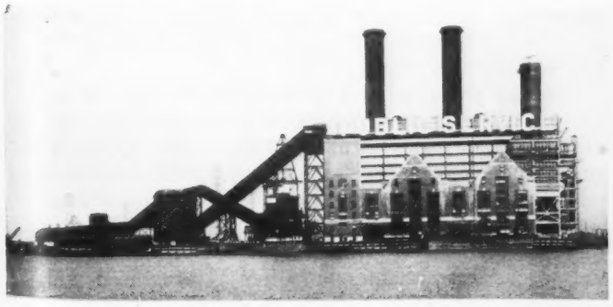
20 ft. high, 14 ft. wide, with a stroke 4 ft. wide. The sign is equipped with 703 25-watt lamps, spaced on 9-in. centers, and is legible for a distance of 18,000 ft. One illustration shows a sign with letters 10 ft. high at Kearny station and part of the floodlighted buildings. The entire group of buildings comprising this generating plant is floodlighted by means of 72 floodlights, each having a 1,500-watt lamp.

Within a distance of 5 miles between Newark and Jersey City Public Service has three generating stations and its main office building; on this group of buildings there are erected ten signs, ranging in size as shown in the accompanying tabulation. These signs may be seen by passengers on trains going to and from New York City on the Pennsylvania Railroad, Delaware, Lackawanna & Western Railroad, Erie Railroad and Hudson Tubes and by the road traffic in the vicinity. The railroads alone within these areas carry a total of over 93,000,000 passengers per year. When to this is added the very large amount of highway traffic, it will be realized that the signs are indeed valuable advertising media.

The lighting department of Public Service, among its other work, prepares sign specifications for its customers and also co-operates with sign manufacturers and their representatives in giving service and information to any one wanting or needing signs. For the first nine months of 1928 the department's records show that the lighting representatives in the various cities throughout the state

SIZE AND LEGIBILITY OF PUBLIC SERVICE ELECTRIC SIGNS

No. of Signs	Length, Feet	Height of Letters, Feet	Legibility, Feet
1	250	22	19,000
1	211	20	18,000
1	190	12	10,500
4	158–178	10	9,000
2	113	8	7,000
1	65	4	3,600



211-ft. roof sign is used on Kearny power station. The effect of combining floodlighting and electric sign at Kearny is shown

have given information and advice which have resulted in the addition of 1,390 kw. of connected load, from which an estimated yearly revenue of $153,322 is derived by the Public Service Electric & Gas Company.

In connection with this increase in sign load, it is definitely known that the electric signs erected on Public Service buildings are a valuable factor in promoting the installation of other signs.

India Has Progressed Electrically in Recent Years

By K. R. Natavajan.
Royapeltah, Madras, India

ELECTRICITY is gradually replacing other forms of energy in India. Steam turbines and oil engines are the chief prime movers used in the country, although about half a dozen places obtain their energy from hydro-electric stations. Owing to the fact that power is developed only in small quantities in plants scattered over the country the cost of power necessarily is high, which checks the development of industry. As hydro-electric developments and larger steam stations are interlinked it will become possible to supply the country with cheaper power and a tremendous impetus will be given to its industrial future.

The main uses to which electricity is put are cotton mills, railway workshops, lighting and fans, flour mills, pumping and petty industrial needs. But the suburban trains in the city of Bombay are run by electricity. The South Indian Railway Company is taking steps to electrify the Madras-Chingelput suburban train service. About a dozen tea factories in South India have decided to use electricity for power purposes, and others may adopt a similar policy.

There is considerable interest all over the country in electrical development, but one of the causes retarding progress has been the dearth of technically qualified men to advise and carry out the work. In spite of the number of technical graduates being turned out yearly by the technical institutions in India, the number of qualified men with sufficient practical experience to carry out schemes is insignificant.

A Newspaper Man on Utility Publicity

Comments by*
Louis Wiley
Business Manager New York "Times"

Public good will is essential to any business and is best obtained by appeals to the intelligence.

* * *

The public must be kept informed by the most straightforward presentation of facts.

* * *

The sole test of public service corporations should be "What are your methods and return to the public?"

**Before Advertising Club of New York.*

Letters from Our Readers

Toleration of Exposed Meter Connections Cause of Current Theft

To the Editor of the Electrical World:

An editorial in the Nov. 24 issue of Electrical World dignifies current theft by the title "Compulsory Free Service," and if the gloomy outlook expressed is really worth consideration remedies should certainly be applied and not simply visualized.

Substantially all current theft is the result of tolerating the installation and maintenance of unmetered conductors that are so exposed that energy-consuming devices may be readily connected thereto. The greater majority of such improper connections will be usually found at the service switch and fuse, this being the most readily available point suitable for such connections.

It is admitted that legitimate access to the service equipment by the consumer for the purpose of service control or fuse replacement cannot be denied. The utility, however, has the obvious right to insist that its seals shall not be violated, when the service equipment is such that access to the switch and fuse for any legitimate purpose can be provided without tampering with them. Furthermore, when the equipment is designed so as to make it impossible to expose live fuses, where seal is intact, such insistence cannot do otherwise than command the co-operation and sympathy of all inspection or judicial bodies on the ground of safety. It can be pointed out that the seal does not in any way interfere with legitimate service, but is merely an additional protection for the consumer.

Seal maintenance as a safety precaution places no undue emphasis on the hazards of our industry, as the United States Bureau of Standards says "the handling of live terminals in metal inclosures presents a greater hazard than where such terminals are not inclosed," and the Fire Code insists upon such inclosure at the switch.

What is needed is a practically enforceable specification to cover the entire subject of interior wiring formulated by the friends and not by the "gyps" of the industry, as the standards of workmanship and material offered by the latter serve no other purpose than to make the present unfortunate speculative building program a possibility.

There is not a meter superintendent in this country without definite and commercially practical ideas of how to minimize current theft in his territory, and his ideas have been considered by the sectional and national meter committees for years, but these ideas lack codification and distinct expression simply because the situation has been allowed to muddle along either because of a lack of definite policy or that the situation was really not worth while bothering about.

Current theft will continue to be an annoyance just so long as we place a commodity worth stealing in a location which provides an undisturbed opportunity to pilfer and dispose of our product without a trace, and while its observed volume varies in different territories practical installation methods which provide for and insure safe handling and which leave an unmistakable record of hazardous fuse replacement offer a recognized and dependable cure for the disorder.

C. E. Palmer,
President.

The Palmer Electric & Manufacturing Company,
Waltham, Mass.

Digest of Electrical Literature

Hydro-Electric Development and Steam Equipment

Propeller-Type Waterwheels Have Adjustable Blades.—The hydro-electric developments at Chippewa Falls, Wis., are described in this article. This station has six generating units totalling 21,600 kw. and a number of interesting features have been included in the design. The propeller type turbines have been provided with movable blades which may be adjusted to obtain maximum efficiency and output under varying operating conditions. Ice formation is prevented by the use of a bubbler system operating with 80 lb. air pressure. Control equipment has been centralized so that the operator at the switchboard has full control over the performance of the units, including starting and stopping. Operation has been simplified to the extent that the only manual features involved are the closing of the starting switch by the switchboard operator and synchronizing of each of the units as they are put on the bus. The remaining steps in the completion of the operation are automatic and enable the generators to assume their share of the load as predetermined by load-indicating devices. —*Power*, Dec. 4, 1928.

Tests of the Fatigue Strength of Steam Turbine Blade Shapes.—Herbert F. Moore, Stuart W. Lyon and Norville J. Alleman.—A critical analysis of the characteristics of steam turbine blades. The authors have pointed out that in studying the strength of any machine or structural member the problem must be considered from at least two viewpoints, namely (1) the number, direction and magnitude of the stresses set up in the part under conditions of service and (2) the strength of the part to resist those stresses. The tests herein reported constitute a study of the strength of steam turbine blade shapes of several different metals to resist many cycles of reversing bending stress; they throw no light on the stresses such blades would be called upon to withstand in service. It is, however, known that in service steam turbine blades are subjected to many cycles of bending stress superimposed on a steady stress due to centrifugal force. The methods used in securing the desired observation have been fully outlined.—*Bulletin No. 183, Engineering Experiment Station, University of Illinois.*

The Change of State from Liquid to Vapor.—According to H. L. Callendar, Van der Waals' theory of the continuity of state between a liquid and its vapor had been more attractive to the mathematician than to the experimentalist. The implication that the meniscus disappeared at the critical point, the latent heat also vanished, that the tangent to the border curve became horizontal at this point, and that here also the isothermal corresponding to the critical temperature had a point of inflexion, is implied. According to Professor Callendar, Van der Walls' equation failed to represent the density of the liquid, and as regarded the vapor phase, it was inconvenient in form. Investigations were conducted to gain further information regarding the change of state from liquid to vapor and the results have been presented in this discussion. The co-aggregation theory has been verified by three independent methods, which have all yielded results in close agreement. This independent evidence is said to have a cumulative value and gives a full warrant for the conclusion that the theory is valid over the whole range up to pressures of 4,000 lb. per square inch.—*Engineering (England)*, Nov. 30, 1928.

Transmission, Substations and Distribution

Symmetrical Components of Unbalanced Three-Phase Systems.—G. W. Stubbings.—The general problem of the resolution of unsymmetrical three-phase systems into symmetrical components of opposite phase sequence has been considered in this discussion. Examples of the composition of balanced systems of opposite sequence are first considered and the methods of resolution are deduced analytically by the use of a vector operator which gives a rotation through 120 deg. The methods of resolution so obtained are interpreted geometrically. It is shown that a consumer taking an unbalanced load from three-phase supply mains gives rise to a generation of negative sequence power. Voltage unbalancing is corrected by rotating machinery which tend to act as phase balancers, but at the expense of reduced rating and impaired efficiency. Proposals to penalize consumers taking unbalanced loads are briefly examined and methods given of measuring directly the symmetrical components of unbalanced voltage and current systems.—*World Power (England)*, November, 1928.

The Design of Small Transformers. —J. K. McNeely and E. R. McKee.—In discussing the design of small transformers the authors have devoted particular attention to the construction of a core type transformer for minimum yearly cost. Among the topics considered are the design, development of equations for total yearly cost, equations giving kilovolt-amperes and losses of transformer in terms of densities and dimensions, calculations of dimension ratios for minimum yearly cost, formulas and curves for calculating design, effect of copper space factor and grade of iron, and similar data. The prediction of coil temperature rises from the oil rises has likewise been considered and a summary and discussion of 1923 and 1927 transformers included. It is stated that the design of a transformer for a particular service can only be satisfactorily developed through the co-operation of those having complete information on the operating requirements and the designers who understand how to build the transformers.—*Bulletin No. 87, Iowa State College.*

Units, Measurements and Instruments

Sine and Tangent Charts for Transmission Systems.—C. Breitfeld.—For the exact calculation of what has been called the equilibrium or the steady-state of a transmission line at any given point from the data available for one point requires the extensive and cumbersome use of hyperbolic functions. Several years ago Latour, Viard, Mailloux and Brown proposed a greatly simplified method for the solution of this problem, by using specially constructed tangent charts. The present author tends to make this principle applicable for a wider range of application by introducing Rössler's equations. At the end of the highly mathematical paper the writer gives two examples of high-voltage transmission lines, the characteristics of which are computed by this semi-graphical method. It is stated that while such examples would require several days of work to solve them by hyperbolic functions, the tangent charts will give just as accurate results in two to three hours.—*Elektrotechnik und Maschinenbau*, Oct. 28, 1928.

Alternating-Current Bridge Methods. —B. G. Churcher.—A discussion of the use of alternating-current bridge methods in the testing of electrical apparatus, especially for the measurement of power. The errors arising in wattmeter methods due to the use of instrument transformers are discussed and the superiority of bridge methods where low power factors are involved is pointed out. The author has devoted particular attention to the testing of synchronous condensers and has listed a number of causes of potential errors in such determinations. An attempt has been made by the author to simplify the test work and the background of mathematical consideration has been developed.—*Electrician (England)*, Nov. 9, 1928.

Standardization of Frequency.—Seikichi Jimbo.—As the result of a complete investigation of the various methods for measuring frequencies the author has recommended the stroboscopic and phonic motor methods. The results of determinations regarding the

characteristics and performance of other methods of test have been included and certain recommendations for the improvement of devices now in use have been offered.—No. 236 *Researches of the Electrotechnical Laboratory of Japan.*

Heat Applications and Material Handling

Northcliffe House, London.—A description of the extensive electrical equipment of one of the largest and most modern newspaper establishments in England, which has a printing capacity of 576,000 copies of a twenty-page newspaper per hour. The total power requirements for this establishment approximate 2,500 hp. and distribution system switchgears and applications have been covered.—*Electrical Review (England)*, Nov. 16, 1928.

How to Correct Low Power Factor.—OTTOMAR H. HENSCHEL.—The article gives the result of low power factor on either purchased or individual generation of electrical power. It gives the reason for low power factor existing. It gives a means of determining the power factor, explaining accurately the steps to be taken. A chart is given which shows how to determine the amount of active kilovolt-amperes required to raise the power factor from a given value to the desired value.—*Industrial Engineering*, December, 1928.

Electrophysics, Electrochemistry and Batteries

Electric Conduction in Hard Rubber, Pyrex, Fused and Crystalline Quartz.—HUBERT H. RACE.—Polarization and conduction both result in the conversion of electric energy into heat, and it is for this reason that the particular problem investigated by the author is of interest in engineering practice. The heat developed produces increased local and general heating which may be contributing causes to the progressive deterioration and final breakdown of the insulation. The constant potential method explained in this paper provides a means for studying the inherent voltage-current-time relations which are involved in experiments using alternating applied potential. Several methods are used for obtaining conducting surfaces on the specimens for constant potential tests. An improved method was devised for making tests and experimental results on four materials were obtained. A summary of experimental results is followed by suggestions for further research along similar lines.—*Journal of the American Institute of Electrical Engineers*, November, 1928.

The Effect of Repeated Stresses on the Magnetic Properties of Steel.—M. F. FISCHER.—Changes in the magnetic properties of steel generally accompany changes in other physical characteristics. This suggested the possibility of detecting and following the progress of a fatigue crack by magnetic methods, and as a result of his investigation in this subject the author concludes that repeated stresses of the reversed-bending type affect the magnetic properties of the materials studied; magnetic changes accompanying repeated stresses are not characteristic of the effect of a fatigue crack traverse to the direction of magnetization; imminence of failure is not indicated by the magnetic changes: the character of the magnetic changes differs according to the material of which the test sample is made; the magnitude of the magnetic changes for a specific material is a function of the applied stress, the number of cycles of its application and the values of the magnetizing force at which the changes are observed.—*Bureau of Standards Journal of Research*, November, 1928.

Telegraphy, Telephony, Radio and Signals

The Technical Side of "Talkies."—E. W. GALLEY.—A description of the Western Electric Company's apparatus for the projection of moving pictures and synchronized sound. Photographs of installations and a description of the operation of the film have been included. A method of correcting production for line voltage fluctuation up to 10 per cent is offered.—*Electrical Review*, Nov. 30, 1928.

Carrier Systems on Long-Distance Telephone Lines.—H. A. AFFEL, C. S. DEMAREST and C. W. GREEN.—A description of recent activities of the Bell system in the development of long-distance multiplex telephone systems using carrier-current methods. The new plan which supplants earlier designs of equipment is described in detail, together with suitable repeaters and pilot channel apparatus for insuring stability of operation. Line problems and typical installations have likewise been considered and the growth of the application of carrier telephone systems and their increasingly important part in providing long-distance telephone service on open-wire lines have likewise been evaluated.—*Journal of the American Institute of Electrical Engineers*, December, 1928.

The Present Status of Wire Transmission Theory and Some of Its Outstanding Problems.—JOHN R. CARSON.—The rapid development in the technique of wire transmission and the increasing complexity of the problems involved calls for a more adequate theoretical guide and a more rigorous transmission theory. The author has given an account, practically without mathematics, of the classical transmission theory and its limitations, of the several ways the problem may be attacked more fundamentally and rigorously and of the lines along which transmission theory must be extended as indicated in the light of this observer's experience. The term wire transmission theory has been accepted to mean the mathematical theory of guided wave propagation along a system of parallel conductors which is supposed to be geometrically and electrically uniform throughout its length. The thory of wave transmission along such a system is of fundamental theoretical and practical importance to the communication engineer and presents extremely interesting and difficult problems to the mathematician.—*Reprint B-311 Bell Telephone Laboratories, Inc.*

Miscellaneous

Increased Use of Electricity in Norway.—A. BJERKE.—The capacity of generating equipment installed in Norway from 1917 to 1927 has increased by 95.5 per cent; that is, from 976,230 to 1,908,407 kw. The total output of the generators increased by 53.5 per cent. The average connected load per inhabitant was 131 watts in the country and 282 watts in the towns. The invested capital for electrical plants amounted in 1921 to 510,000,000 kronen, in 1923 to 630,000,000 kronen, in 1924 to 700,000,000 kronen and in 1925 to 750,000,000 kronen. As distinct from the number of installed lamps and motors, which has only doubled, the load value of installations for cooking and heating has increased almost ten times, or from 49,942 to 387,317 kw. The increase in the use of electricity for household purposes depends not only on the cheap rates and the many advantages that electricity offers but also upon the fact that appliances have been reduced in cost.—*Elektroteknisk Tidskrift*, Oct. 25, 1928.

Weldless Steel Drums for High-Pressure Boilers.—The methods of fabricating the drums for high-pressure boilers from ingots of unusually large size has been pointed out in this article, and the characteristics of the material and test procedures and standards are included.—*Engineering (England)*, Nov. 30, 1928.

Tests of the Effect of Brackets in Reinforced Concrete Rigid Frames.—FRANK E. RICHART.—A report of the results of analyses and tests of rigid frames of reinforced concrete with and without enlargements termed brackets at the intersection of the horizontal top member with the vertical legs. All the frames tested were of inverted U form hinged at the lower end of the vertical legs. The application of formulas derived for the freely supported frames to the case of inverted U frames with legs fixed at the bottom or of closed frames is also made possible by showing that the vertical distance from the horizontal member to the point of inflection of the leg may be substituted for the total height of the freely supported U frame with nearly correct results. An empirical expression for the moment of inertia for use in determining the distribution of moments has been developed which should greatly assist in the preliminary or even final design of a frame.—*Research Paper No. 9, Bureau of Standards.*

News of the Industry

Swing-Johnson Bill Becomes a Law

President Signs the Amended Measure Providing for Dam at Black Canyon—Recommendations of Reclamation Bureau Closely Followed—Provisions of Bill

By Paul Wooton
Washington Correspondent for the Electrical World

FOLLOWING more than five years of vicissitude, the Swing-Johnson bill providing for the governmental construction of a dam in the Colorado River for flood-protection, irrigation and power-generating purposes became, in its final form, a law on Friday, Dec. 21, when President Coolidge signed it in the presence of its sponsors, Senator Johnson and Representative Swing of California, and others. The bill authorizes the expenditure of $165,000,000 to build a dam at Black Canyon, and it makes possible an ultimate public or private development of electrical energy put at 1,000,000 hp.

The act contains the principal features of the recommendations of the Bureau of Reclamation. The site is that which the bureau recommended. The capacity of the reservoir was fixed at that worked out by the engineers of the bureau. It also was their suggestion that the power revenues be applied on the capital expenditures by the government. The bill includes the All-American Canal, which is to be built and paid for under the provisions of the reclamation law. The original recommendation that construction be undertaken on approval of six or seven states also came from the bureau.

At least a year must pass before construction can be begun. It is believed that length of time will be required for ratification of the preliminary surveys and to handle the competitive bidding for the power. It is expected that $50,000 will be carried in the second deficiency bill to take care of preliminary studies and the preparation of plans which can go forward in the meantime. The steps for carrying out the development have been outlined by the Bureau of Reclamation as follows: (1) Ratification of the seven-state compact; (2) preparation of plans and estimates for the dam and power house; (3) contracts for power revenues; (4) building of the dam by the government and building of the power house by the government or private parties; (5) building of the All-American Canal from the headgate down to the international boundary; (6) building the remainder of the canal if satisfactory agreement with Mexico cannot be secured, or if the irrigation interests that are to pay for this canal desire it to be constructed and enter into a satisfactory contract to cover the costs.

Before the dam can be begun or contracts made for the power house the offers for power must be large enough to repay the money spent by the government, with 4 per cent interest, less the flood-control item of $25,000,000. If such contracts are secured, then the next step would be to provide for the construction of the dam, and this would probably be under a contract.

A digest of the act as it will appear on the statute books is as follows:

1. The act authorizes the Secretary of the Interior (1) to construct, operate and maintain a dam at Boulder or at Black Canyon, sufficient to store not less than 20,000,000 acre-feet; (2) to construct and maintain a main canal to supply water to the Imperial and Coachella Valleys in California; (3) to construct or cause to be constructed at or near the dam a power plant and incidental structures.

2. The Secretary of the Interior may, in his discretion, lease a unit or units of a government-built plant with right to generate electrical energy, or, as an alternative, contracts may be made for the use of water for generation of electrical energy, the necessary plant and appurtenant structures to be built by the contractor. Provisions of the federal water-power act, so far as applicable and in harmony with this act, shall govern.

3. Water stored in the reservoir shall be used, first, for river regulation, improvement of navigation and flood control; second, for irrigation and domestic uses; third, for power. Title to dam, reservoir, plant and incidental works shall forever remain in the United States.

4. A Colorado River dam fund is established, from which all expenditures are to be made and into which all revenues must be covered; financial features under jurisdiction of the Secretary of the Treasury.

5. Necessary appropriations from the Treasury are not to exceed $165,000,000, authorized to carry out work described.

6. Twenty-five million dollars allotted to flood control to be repaid from 62½ per cent of the revenues, if any, in excess of amount necessary to repay charges within amortization period of fifty years. If this sum be not repaid in full within that period, 62½ per cent of all revenues shall be applied thereafter to payment of remainder.

7. The act shall not become effective until the Colorado River compact is approved. This compact shall control the storage, diversion and use of water. The compact shall be approved by the seven basin states, or if not so approved within six months, approval by six, one of which must be California, will be sufficient.

8. Before any money is appropriated for the construction of the dam or power plant contracts must be made that will be adequate, in the opinion of the Secretary of the Interior, to return cost of construction with interest at 4 per cent. No work shall be done on the main canal until contracts are secured sufficient, in the opinion of the Secretary, to return all cost of construction, operation and maintenance in accordance with the reclamation law.

9. All irrigable public lands shall be subject to entry under reclamation law, and preference right of entry will be given to soldiers, sailors and marines, who also shall be given preference in employment so far as practicable.

Denver Reclamation Engineer Sees Eleven Years' Work

By instructions from Washington, the engineering work for the building of the Boulder Dam will be handled in the Denver office of the United States Reclamation Bureau. Raymond F. Walter, chief engineer, will have a force of about sixty engineers working with him, according to a report from Denver. "It is not likely that we will advertise for bids on the construction of the Boulder Dam until about this time next year," Mr. Walter is reported as saying. "Under normal conditions we expect that in seven years we shall have completed the dam and the All-American Canal, and two, or maybe four, of the thirteen units of the power plant. About four years later the other nine units of the power plant will be completed if the demand for power proves sufficient."

Much jubilation from Los Angeles and southern California was reported when the news of the President's prompt action reached the Pacific Coast. This satisfaction was echoed from Las Vegas, Nev., 41 miles from the dam site, whence a railroad to convey material to the site will be built and where the federal government may construct a generating plant to supply power for the work of construction. Arizona legislators, on the other hand, in session at Phoenix, were said to be downcast because pleas for a veto made by the state's representatives had failed. No definite plans for a legal contest by Arizona have been reported.

Commission Will Control State Line Bulk Rates

An opinion on the authority of the Indiana Public Service Commission to approve or disapprove 50-year wholesale power contracts between the State Line Generating Company and four other Insull electric companies were given recently to Commissioner Harvey E. Harmon by Arthur L. Gilliom, Attorney-General of Indiana. Mr. Gilliom said that the State Line company, though it will sell electrical energy only at wholesale, will be a public utility and

come under utility laws. Approval of the contracts by the commission, he said, will be necessary before operation.

Wholesale power rates suggested by the State Line Generating Company, the Attorney-General averred, should be treated by the commission as though they constituted a flat-rate schedule, which would leave with the commission authority at any time to investigate reasonableness of return, valuation, rate of plant depreciation and such other questions as are in the commission's province. The 50-year contracts which the State Line company has asked to have approved, propose rate schedules based on cost of operation plus 8 per cent return plus an allowance for depreciation, with consideration also of the fluctuating cost of coal.

The four Insull companies which are building the generating plant on Lake Michigan, near Hammond, Ind., to cost ultimately $28,500,000, and which are to consume its output of power on a basis proportionate to their ownership of stock in the enterprise, are the Commonwealth Edison Company, the Public Service Company of Northern Illinois, the Northern Indiana Public Service Corporation and the Interstate Public Service Company of Indiana.

New York Companies Adopt New Policies

Engineering Department Formed to Design Utility Buildings and Equipment—Merchandising of Household Accessories to Be Instituted in the Near Future

TWO radical changes in policy have just been made public on behalf of the five associated electric light and power companies of Greater New York and Yonkers, now all headed by Matthew S. Sloan. From now on these companies will have their own engineering department to design new equipment and buildings formerly designed and built by outsiders, and in the near future a policy of merchandising household equipment will be adopted. The reorganized engineering department within the New York Edison-Brooklyn Edison consolidation will be headed by Charles B. Grady, mechanical engineer for the New York Edison Company.

The engineering work for the New York Edison Company and the Brooklyn Edison Company formerly was done almost exclusively by Thomas E. Murray, Inc., consulting engineers, headed by Thomas E. Murray, formerly vice-president of the New York Edison Company. Mr. Murray's engineering concern designed numerous large plants costing many millions of dollars for the New York Edison Company and also designed and built numerous other large plants throughout the country. He is the inventor of many devices now used in large generating plants of the New York Edison and other light and power companies.

By the decision of the New York Edison and affiliated companies to organize an engineering department to take over the work formerly performed by Mr. Murray's engineering corporation President Sloan expects to effect material economies.

"We do not say that we will do the work any better than Thomas E. Murray, Inc., but we believe that the consolidated companies are big enough and have brains enough within their organization to do their own engineering work," said Mr. Sloan. "Our own engineers are already at work on plans for plant enlargements. We have taken over about 150 members of the staff of Thomas E. Murray, Inc., and will keep such as we need."

Mr. Sloan said that the consolidated and affiliated companies planned no new plants for the immediate future, so that the engineering department at first would not be confronted with any particularly difficult problem. Its most important immediate task, according to Mr. Sloan, is the installation of the new equipment ordered for the East River station.

The light and power companies of New York are several jumps ahead of consumption, according to Mr. Sloan. The East River plant alone has abundant room for additional machinery, and additional plants probably will not have to be built for two years, although the companies have four or five sites available for new plants in Manhattan, Brooklyn, Queens and the Bronx.

New York Edison to Merchandise

Preliminary announcement has been made that the New York Edison Company will before long enter actively into the merchandising of domestic electrical appliances on an extensive scale. This company for years has been an outstanding exponent of the policy of advertising the uses of electricity only and leaving the actual retailing of all electrical appliances to the independent dealers. The change of policy comes as a result of the reorganization that has followed the election of Mr. Sloan as president of the company and indicates a probable uniformity of policy among the metropolitan utilities of which he is now the chief executive.

No detailed information is yet available as to the extent of the sales plans which will be inaugurated or the character of the advertising or trade relations program which will support it. This is in process under the direction of C. W. Low, acting general commercial manager. However, Mr. Sloan is scheduled to address the January luncheon of the New York Electrical League in the ballroom of the Hotel Astor on Jan. 9, at which time he has indicated his intention to discuss the new merchandising policy of the Edison company and other plans for the more intensive development of the local market.

Purchases and Mergers

Georgia Power Company Absorbs Augusta-Aiken Railway & Electric and Georgia-Carolina Power Company—Niagara Consolidation Advanced

PROPERTIES in Georgia of the Augusta-Aiken Railway & Electric Corporation and the Georgia-Carolina Power Company have been purchased by the Georgia Power Company and will in the future be operated as integral parts of that system, according to an announcement just made by President Preston S. Arkwright. The utilities involved, in addition to their street-railway service in Augusta and the interurban line to Aiken, S. C., supply electric light and power to 31 small Georgia communities. The Augusta properties have been managed and operated by the J. G. White Management Corporation, New York. This announcement, following close upon the consolidation of the Macon Railway & Light Company and its allied utilities with the Georgia Power Company, brings the total number of cities and towns served by the latter up to approximately two hundred. F. B. Culley, vice-president and general manager of the Augusta-Aiken company, will continue in charge, with the title of division manager for the newly created Augusta division of the Georgia Power Company.

As foreshadowed in the ELECTRICAL WORLD, the Buffalo, Niagara & Eastern Power Corporation has applied to the Public Service Commission of New York for permission to organize the Niagara Power Corporation, which is intended to consolidate all the Schoellkopf public utility properties, including the Buffalo General Electric Company, the Niagara Falls Power Company, the Niagara Electric Service Corporation, the Niagara, Lockport & Ontario Power Company, the Tonawanda Power Company and the Lockport & Newfane Power & Water Supply Company.

Phillips B. Shaw and Leo Loeb have resigned as vice-presidents of the National Electric Power Company and have, in association with others, acquired two properties formerly owned and operated by the United States Electric Power Corporation, an Albert Emanuel organization. These are the Washington Gas & Electric Company, serving Longview with electrical energy and many communities, including Tacoma and Olympia, with gas, and the Dominion Electric & Power Company, serving about forty communities in Saskatchewan, Canada.

The New England Public Service Company, Augusta, Me., has acquired a controlling interest in the Union Water Power Company of Lewiston, Me., through purchase of the Hill Manufacturing Company of Lewiston. Important hydro developments and rights on the Androscoggin River are involved.

The receiver for the Northern Wisconsin Hydro-Electric Power Company, Bayfield, Wis., sold the property recently to David G. Fisher of Davenport, Iowa, for $163,800.

An offer of $45,000 has been made by the South Carolina Power Company of Charleston to the Barnwell (S. C.) City Council for the municipal electric plant. The proposal will be submitted to a vote.

P. G. & E. Business Plans

Commercial Department Banquet Hears of Success Attained in 1928 Through Co-operative Means and Still Bigger Program for 1929

NEW business added to the system of the Pacific Gas & Electric Company during 1928 will approximate $4,800,000 in annual revenue, and a quota of $5,257,300 has been established for 1929, with a sales budget of almost a million dollars. These facts were brought out at a banquet meeting of the entire commercial department, together with executives of the company, held in San Francisco on Dec. 21, with 580 in attendance. R. E. Fisher, vice-president in charge of public relations and sales, presided. Telegrams in high praise of the company's sales achievement and program were received from C. E. Greenwood, commercial director of the N.E.L.A., and Kenneth A. McIntyre, managing director of the Society for Electrical Development.

In reviewing the accomplishments of the commercial department in 1928, it was pointed out that only $800,000 of the original budget of $982,000 was spent in gaining new business. The sales organization has increased from 241 on Jan. 1 to 400 at the present time. During the year 28 sales schools with 394 salesmen in attendance were held through the co-operation of manufacturers and jobbers. Eighty-two meetings of employees brought together 4,200 in co-operative endeavor. Of the new business secured, 79 per cent of the electric load and 96 per cent of the gas business required no additional investment in facilities. Approximately $129,000 was spent in advertising. To obtain co-operation with dealers 738 meetings were held with 13,300 in attendance. Kilowatt-hour sales increased by 132,000,000, resulting in an addition of $1,800,000 in gross earnings. There would have been an additional increase of $990,000 had it not been for the decrease in rates early in the year.

P. M. Downing, vice-president in charge of operation, assured the commercial department that there would be ample energy for sale during 1929 when he said: "We shall have in excess of 1,500,000,000 kw.-hr. in 1929. We are prepared for any demand created by this sales program." The salient points of the 1929 program, brought out by H. M. Crawford, general manager of sales, were as follows: Electric and gas appliances to be sold by the commercial department will have a value of $2,250,000, and will include 40 carloads of electric ranges, 17 carloads of lighting fixtures and 19 carloads of small air heaters. The sum of $125,000 will be spent on advertising in 165 newspapers, in addition to 600,000 bill inserts, 98,000 employee broadsides and 1,400,000 consumer broadsides. A bonus fund of $10,000 has been set up to secure the co-operation of the employees in putting over the sales program. Commissions to be paid the salesmen will amount to $440,000.

Following the presentation of the sales plan, A. F. Hockenbeamer, president of the company, and F. A. Leach, Jr., vice-president and general manager, voiced their approval.

Building Owners Threaten to Use Isolated Plants

Hearings by the New York Public Service Commission on questions connected with the practice of submetering by meter-service companies and landlords will be resumed in New York City on Jan. 2.

Following the efforts of the electric light and power companies operating in the five boroughs to have the Public Service Commission allow them to refuse energy to premises that are submetered, the Building Managers and Owners' Association of New York has begun a study of the effect such a refusal would have upon their properties, particularly in Manhattan. Their counsel says it would mean the loss of hundreds of thousands of dollars by the change of equipment that would be necessitated. Owners have gone to the expense in many cases of purchasing electric meters outright, installing them and wiring for individual offices or apartments, he declares. In addition, the counsel says, there is the expense of making annual tests of the meters and billing the tenants. Some owners threaten to put their retired isolated electric plants into active service if the utility corporations win.

Georgia Commission Aids Use of Domestic Equipment

Following three hearings at which representatives of the Georgia Power Company, the city of Atlanta and other Georgia communities were heard, the Georgia Public Service Commission has set new power rates for the company. It has ordered an increase in the rates charged consumers of less than 50 kw.-hr. and gradually increasing reductions in the rates charged consumers using more than this amount. A service charge of $1.11 for a meter of less than 10-amp. rating and a charge of $2.22 for a meter of more than that capacity are approved.

The old rate for electricity in Atlanta was 9 cents per kilowatt-hour, with a 10 per cent discount for prompt payment. The new rate is 5.5 cents for the first 50 kw.-hr., 3.35 cents for the next 150 kw.-hr. and 2.22 cents for more than 200 kw.-hr. It is the addition of a service charge that makes the new rate to small consumers higher than the old one. A table issued by the commission shows these comparisons: For 15 kw.-hr., $1.22 under the old rate and $1.75 under the new; for 30 kw.-hr., $2.43 and $2.50; for 50 kw.-hr., $4.05 and $3.50; for 100 kw.-hr., $8.10 and $5; for 200 kw.-hr., $15.30 under the old system and $8 under the new. The commission ordered the removal of all coin-in-the-slot meters.

There were three important elements in the decision handed down. One was that changing conditions made it no longer advisable for smaller communities to have a higher rate of payment than larger ones; the second was the allowance of a definite service charge to cover fixed expenses, and the third element was recognition of the increasing use of electric stoves, refrigerators and other appliances. The commission declared that it aimed to encourage the use of these appliances through lower rates to large users.

The company's valuation figures were objected to by the attorney for Atlanta and the attorney for the Atlanta Federation of Trades, but Chairman Perry of the commission ruled that the figures submitted should be accepted.

In regard to an 8 per cent return on the investment, Chairman Perry stated that the commission had never adhered to a policy of allowing an 8 per cent return on the investment of any public utility. It had ruled, he explained, that such a return was not unreasonable, but did not set that figure as a fixed return.

Progress of Railroad Electrification in the Past Year

In a review of the year 1928 in the electric railway field, W. D. Bearce of the railway engineering department, General Electric Company, says that the most important steam railroad electrification initiated was the Cleveland Union Terminals project, plans for which had been under way for several years. This electrification involves 17 route miles and will employ 3,000-volt direct current with overhead catenary supply. There are now under construction at the Erie works of the General Electric Company for handling passenger trains of the New York Central and other roads in and out of this terminal 25 204-ton passenger locomotives, rated at approximately 3,000 hp.

The completed electrification of the Boston, Revere Beach & Lynn narrow-gage railroad is also described.

Both locomotives and car equipment have been installed on the Pennsylvania Railroad. This equipment includes motors and control for four 200-ton locomotives built by the railroad company for operation at the New York Terminal and 30 single-phase motor-car equipments for the new Wilmington and Westchester divisions.

Delivery has been made during the year of additional passenger locomotives to the Paulista Railway in Brazil, bringing the total number of the heavy 150-ton type up to five units and the total number of all General Electric locomotives to 26 units. Two 260-ton locomotives similar to those installed last year have been placed in service by the Great Northern Railway on the electric zone through the Cascades, in Washington State. Operation through the new 7¾-mile Cascade tunnel began on Dec. 28. Two 150-ton, 3,000-volt direct-current locomotives are under construction for the Mexican Railway.

Progress Rapid on Fifteen-Mile Falls Project

Fast headway is being made in the construction of the Fifteen-Mile Falls development of the New England Power Association system in the Upper Connecticut Valley, where an ultimate installation costing about $40,000,000 is planned, including transmission lines into central New England. It is expected that the first or lower development will be in operation by September, 1930. This will add four 30,000-kw. generating units to the system, operating under a gross head of 168 ft. The upper development provides for four units aggregating 105,000 kw.

At present about 1,500 men are at work on the lower development, the winter's program, including the construction of a diversion channel in the river, a large amount of cofferdam work, railroad construction and concrete installation in connection with the intake. Power for construction purposes is being supplied through the Green Mountain Power Corporation and the Bradford Electric Light Company, 33-kv. circuits having been built for this work by the New England Power Construction Company, Boston. Two steam-driven generators are also available at the construction camp for emergency service.

New-Kanawha Plant Is Sanctioned by West Virginia

Formal permission has been granted by the Public Service Commission of West Virginia to the New-Kanawha Power Company to construct a hydro-electric plant and tunnel on New River in the Falls and Kanawha districts of Fayette County, to be known as the Gauley Junction Dam project. To the same company the commission has granted similar authority to construct a hydro-electric plant and tunnel on New River to be known as the Hawk's Nest Dam project.

The permit for the project first mentioned authorizes the company to construct a dam across New River about a quarter of a mile upstream from the Blue Hole tunnel of the Chesapeake & Ohio Railway and in connection therewith a hydro-electric plant and to maintain and operate the project for the development and sale of hydraulic power and hydro-electric energy. Construction is to be commenced within one year from the date of the acceptance of the permit. The state shall regulate the distribution and sale of all power generated, to the extent at its discretion of requiring that such power shall be used within the state. All rights granted are to terminate at the end of fifty years and revert to the state.

The proposed dam will be 47 ft. high above low water, its crest being at an elevation of 727 ft. above mean sea level. The Hawk's Nest dam will be about 36 ft. high, its crest to be at an elevation of 800 ft. above mean sea level. Virtually the same conditions were imposed for it. Estimated maximum capacity at Gauley Junction is 50,000 hp. and average capacity is 36,000 hp. For Hawk's Nest the same figures are given. Initial cost will be $7,000,000 and ultimate cost $9,000,000. The Federal Power Commission has yet to pass on the project.

Regulation by Contract Still Sought in Bay State

A report to the incoming Legislature recommending alternative bills to strengthen its regulative powers over gas and electric companies has been made public by the Massachusetts Department of Public Utilities. The commission still seeks to have companies enter into contractual relations with the state in connection with their regulation, but has relinquished its proposal of last winter by which companies refusing to enter into such relations could not increase their capital stock except by special act of the Legislature and could not exercise the right of eminent domain. The companies attacked these provisions on the ground of unconstitutionality.

The report declares that representatives of some of the larger companies have indicated a willingness to enter voluntarily into regulative contracts, provided that the basis of capitalization shall be upon book cost rather than upon stock plus premiums and plus that portion of the surplus which would give the stockholders an average of 7 per cent dividend. The commission states that this would be a recognition that the surplus belongs entirely to the stockholders and should be used as a basis of rates. Commenting on this, the board says:

> This is somewhat contrary to the prevailing thought in this commonwealth, but it is a basis which, if availed of at the present time, is less than that apparently allowed in the recent decisions of the United States Supreme Court. We have been unable sufficiently to agree to the details of this suggestion and the basis upon which the suggestion is made to warrant us in recommending any bill at the present time to that effect. If, however, the Legislature should be of the opinion that these suggestions of the companies form a proper basis for legislation of a contractual nature, the bill we recommend can be readily modified to accomplish that result.

Index Published Separately

THE index to the June-December, 1928, issues of the ELECTRICAL WORLD will be published as a separate pamphlet with elaborate cross references. If you bind your copies attach this notice to a sheet of paper, sign it with your name, company position and address and mail it to the Circulation Department, McGraw-Hill Publishing Company, Inc., Tenth Avenue at 36th Street, New York City, and an index will be sent to you.

Welland (Ontario) Commission Fixes New Rates

The Hydro-Electric Commission of the city of Welland, Ontario, working in co-operation with the Hydro-Electric Power Commission of that province, announces a rate reduction for all classes of commercial service which, it says, will net an annual saving of $1.50 per capita to consumers. The new rates, as sent by the Welland commission to the ELECTRICAL WORLD, are as follows:

Domestic: Service charge, 33 cents and 66 cents for two-wire and three-wire services; 60 kw.-hr. per month at 2.2 cents, remaining consumption at 1.1 cents per kilowatt-hour, the entire bill being subject to 10 per cent prompt payment discount.

Commercial lighting: Service charge, 5 cents per 100 watts of connected load or maximum demand; energy charge, 100 hours' use of maximum demand or connected load at 2.2 cents; all remaining consumption at 1.1 cents; prompt payment discount, 10 per cent.

Commercial power rates: Service charge, 90 cents per month per horsepower of maximum demand or connected load; energy charge, first 50 hours' use of maximum demand at 1.44 cents; second 50 hours' use of maximum demand at 0.9 cent; all remaining consumption at 0.297 cent per kilowatt-hour with a 10 per cent prompt-payment discount.

Southern California Edison Plans for 1929

R. H. Ballard, president of the Southern California Edison Company, announces that the board of directors of the company has approved a budget of $29,260,214 for the year 1929. This expenditure will be largely for reinforcement and extension of the distribution system, including twelve new substations, and will be a part of the expansion program, involving $130,000,000, outlined by the company for the next five years. "During the present year, the first under our new program, which we term the 'commercial era,'" Mr. Ballard says, "we have sold 300,000 hp. of electricity in new business, an increase of 40 per cent over the previous year. The plans for 1929 call for 375,000 hp. in new business. When an increased generating capacity is demanded to keep abreast with this expansion we can meet the demand by additions to our present hydro and steam plants."

The 1929 appropriations will be spent in the ten counties of southern and central California served by the Southern California Edison Company system. The new general office building in Los Angeles, already announced, will be constructed at a cost of $2,500,000. Funds will be allotted to the 32 districts through which the company operates and the Big Creek-San Joaquin and Long Beach generating plants for expansion of service facilities and continuation of generating development. With the completion during the past year of the fifth of a series of hydro-electric power plants as a part of the Big Creek project in the High Sierras, the company now has a capacity of 460,000 hp. of electrical energy from

this source. Other water-power plants and the steam generating plants at Long Beach furnish an interconnected generating capacity of 1,061,000 hp. The company serves an area of 55,000 square miles, including 360 cities and towns with a population of approximately three million.

Three-Cent Rate Foundation of Rural Schedule

Recommendations for the extension of rural service in Connecticut have been made by a committee sponsored by the State Agricultural Department and representing farm bureaus and granges and eighteen light and power companies. Among this committee's members are Samuel Ferguson, A. V. S. Lindsley, C. E. Carter, Henry E. Lysle and F. M. Fernald. The plan is for a flat rural rate of $2 a month, plus 8 cents per 100 sq.ft. of wired dwelling-house area, plus an energy rate of 3 cents a kilowatt-hour, this rate to be available to customers whose line extension does not exceed 600 ft.

"While it is recognized," the committee says, "that some companies may be so situated as to be able to offer a rate with a higher flat rate and a lower energy charge in order more rapidly to develop a larger use of service on the farm, the committee believes that the 3-cent rate is low enough to make practical the wholesale use of electricity, and it believes that more rapid progress toward the general program of complete state electrification will be made if the companies will for the present universally offer the 3-cent rate."

Federal Electric Award to Promote Advertising

Announcement of a liberal offer by the Federal Electric Company to the public service company that contributes most to the advancement of the electrical advertising industry each year is made at N.E.L.A. headquarters by Commercial Director Greenwood. This contribution may be in the form of (a) a new use for electrical advertising; (b) an identification program, such as has been inaugurated by certain holding companies; (c) an enterprise whereby businesses throughout the country or in a particular community are brought to a keener realization of the value of electrical advertising, or (d) an activity which makes possible better merchandising or electrical advertising displays. The award is a gold medal for the company making the greatest contribution and $1,000 to the individual in that company responsible for this particular achievement.

To encourage immediate activity the Federal Electric Company suggests that the first contest year be retroactive and include the twelve months' period ending Feb. 28, 1929. Exhibits must be filed at the N.E.L.A. headquarters in New York on or before April 15. Announcement of the winner will be made at the annual convention.

T. W. Martin Answers Judson King

President of Alabama Power Company Asks Why Sum Greater than Its Gross Receipts Is Broadcast as Profit from Muscle Shoals Contract

PERSISTENT propaganda of a misleading kind put forth by the National Popular Government League at Washington, of which Judson King is director, has brought forth a rejoinder in the shape of a letter to Mr. King from Thomas W. Martin, president Alabama Power Company, under date of Nov. 26, which has now been issued in pamphlet form.

Mr. Martin's letter was composed as a reply to a pamphlet issued by the league entitled "Efficiency, Prosperity and Economy—Three Years' Operation of Muscle Shoals" and concerns itself with charges that enormous profits have been made by the Alabama Power Company through resale of power purchased from the Muscle Shoals plant. "These statements," Mr. Martin says, "greatly distort the facts; the conclusions have no truthful basis and are misleading in essential details." After exposing the fallacious statement made by the league regarding the output of the plant and the contract under which the Alabama Power Company is governed in its dealings with the government Mr. Martin says:

You "assume" a profit of 5 cents per kilowatt-hour on one-half the power purchased at Muscle Shoals, or $34,825,724.35; a profit of 2½ cents per kilowatt-hour on one-fourth, or $8,700,181.05, and 1 cent profit per kilowatt-hour on the remaining one-fourth, or $3,480,072.42. You then conclude that "the grand total of profits which the Alabama Power Company, by using only 27 per cent of the capacity of Muscle Shoals, must have made out of the current purchase during the past three years from Uncle Sam is approximately $46,980,977.82," and state, by the same process of reasoning, that if the entire output had been purchased for three years, its profits would have been $174,000,000.

The absurdity of these statements is apparent when public records, readily available to you, disclose that the total gross income of the Alabama Power Company for the three years in question from the sale of power from all of its hydro and steam plants, including that purchased from Muscle Shoals, and from operation of five gas and six street railway systems, was only about $46,700,000. This is less than the amount you allege has been profit to the Alabama Power Company from the sale of Muscle Shoals power. From that gross income must be paid all operating expenses, taxes and interest on investment. Perhaps you assume that gross receipts are all profit—there being no expense for operating and maintaining the plants and systems or for interest on investment. Governments may do business in that way—a power company cannot.

"If a power company were to engage in such reckless misrepresentation," Mr. Martin asserts, "it would be denounced and condemned as deceptive propaganda. How can you defend such action on the part of the National Popular Government League in support of the policy of governmental operation?"

Tonawanda Power Company's Electric-Welded Home

ATTRACTIVE in its architecture, the new office building of the Tonawanda (N. Y.) Power Company, a three-story structure, 65 ft. by 135 ft., finished outside in Indiana limestone, has the additional credit of being the first electrically welded light and power office building in the country. Its steel framework was erected, without the noise of riveting, by the Fort Pitt Bridge Company in co-operation with the Westinghouse Electric & Manufacturing Company. The welding equipment consisted of a 200-amp. portable motor-generator set, driven by a three-phase, 25-cycle, 220-volt motor, and a 200-amp. gasoline-engine-driven portable welding set, together with the necessary accessories. It is expected that the building will be ready for occupancy early in January. Special illumination inside and floodlighting outside will enhance its appearance at night. The Tonawanda Power Company is one of the "Niagara Power Service" group.

German Hydro Projects of 1928

Electricity Shown in "Technical Town"—A 50-Cycle, Single-Phase Locomotive—German Public Utilities Association Meets—Plants on the Danube and in Baden

News Letter from DR. GERHARD DEHNE

BERLIN, December 1, 1928.

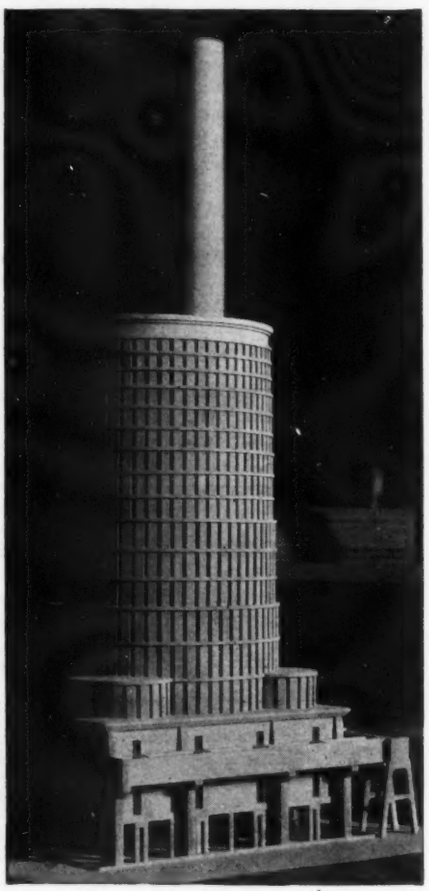
SOME of the electrical events that marked the latter part of the year in Germany are worthy perhaps of transatlantic notice before 1928 gives place to 1929. In Dresden in the fall the exhibition known as "The Technical Town" celebrated in notable fashion the centenary of the Saxon Technical College in that city. The most conspicuous feature was a spherical building in the shape of a globe 82 ft. in diameter and having a volume of 280,000 cu.ft. Set on a base 33 ft. square, it was constructed as a fully equipped five-story business building 99 ft. high. The fifth story contained a coffee room.

Interest of a particular kind attached to an electric locomotive operated on single-phase alternating current at 50 cycles. In the past when line current was used directly on the motors it was necessary to supply a lower frequency for railway use. In Germany it was generally taken at one-third of the ordinary 50-cycle frequency. This low frequency required large transformers and increased the construction costs of electric railways by as much as 30 per cent. Sometimes special plants were built.

The new locomotive takes current directly from a central transmission system, using the recently developed Krupp motor, which, after a careful examination by Professor Punga of Darmstadt, has now been applied to railway operation. Hitherto the single-phase induction motor has not been considered suitable for railway use; but by introducing a short-circuit winding, rotating in the air gap between stator and rotor, the pulsations of the field are removed. The new motor not only has all the advantages of the three-phase motor but surpasses it in some ways. Compensation is possible by feeding the rotating short-circuit winding with direct current. A reactance coil connected into the feeder prevents the spread of railway short circuits into the public utility systems. On down grades braking takes place automatically. One of these locomotives, of 48 tons weight and equipped with two new Krupp motors of 300 hp. each and having a tractive force of 26,000 lb. to 35,000 lb., is used for switching service at a lignite mine near Bitterfeld.

The annual convention of the German Public Utilities Association, jointly with the Union of Austrian Public Utilities, was held in Vienna in the summer. The association, the most important one in the German light and power industry, includes numerically about 40 per cent of all German central stations, but this represents about 95 per cent of the nation's energy output.

In connection with this meeting in the capital of Austria the new project of a water-power plant on the Danube near Yobs-Persenbeug is of interest. It is undertaken jointly by the Wiener Bankverein, the Oesterreichische Kreditanstalt für Handel und Gewerbe and the Swiss Gesellschaft für Elektrische Industrie in Basel. It provides for a dam across the Danube with locks for navigation, together with a power house



Model of cooling tower for mouth-of-mine plant
(Shown at Dresden Exhibition)

having a capacity of 120,000 hp. to 130,000 hp. and a yearly output of 640,000,000 kw.-hr. to 680,000,000 kw.-hr. Vienna, one of the largest prospective markets for the power, will be reached by a transmission line nearly 60 miles long. The Bavarian frontier is equally distant. Thus the energy may also be exported to Germany. The development will also benefit navigation by the flooding of dangerous rapids. The construction time is estimated at four to five years.

In Baden a license has been granted to the Badische Landes-Elektrizitätsversorgungs A.-G. (Badenwerk) to construct the Schluchseewerk in the southern part of the Black Forest. Previously, during the years 1913 to 1918, the Murgwerk had been built a little to the north with an installed capacity of 71,000 kw. and a yearly output of 125,000,000 kw.-hr. The latter was the first great hydro-electric plant with pumped storage in Germany.

There is a 2,100-ft. drop to the Rhine, 15 miles away, from the Schluch-

DATA ON COMING SCHLUCHSEE HYDRO-ELECTRIC PLANT

Stage	Yearly Output, Millions of Kw.-Hr.	Installed Capacity, Kw.	Cost in Millions of Marks*
Upper:			
Without hydraulic storage	56.5	40,000	21.4
With maximum hydraulic storage	126	72,000	....
Middle:			
First development	122	65,000	29
First and second developments	248	130,000	62
Lower	118	60,000	25
"Oberalb"	18.7	11,000	....

*A million marks equals $238,200.

see, the waters of which are to be raised 100 ft., giving a storage of 5,000,000,000 cu.ft. The development is to consist of several stages. Some data on it are contained in the accompanying table.

Progress of Electrification in Palestine

The Rutenberg project for the electrification of Palestine attracted widespread attention about six years ago, but very little has since been heard of it. Although some progress has been made in developing the water resources of the country, the complete scheme will not become a reality until the demand for electricity has increased. So far three small Diesel-electric central stations are in operation, and a hydro-electric generating plant is under construction on the Jordan. The three stations referred to are at Haifa (1,000 hp.), Tiberias (150 hp.) and Jaffa (800 hp.). Energy is generated at 6,300 volts, three-phase, and transmitted to towns within a radius of 15 miles for industrial and domestic purposes. Rates are high—about 50 cents per kilowatt-hour for lighting and 10 cents for power.

These stations will be kept working until the hydro-electric station at Jisr-el-Mujamieh, on the Jordan, near Lake Tiberias, is in operation. The power house at this station is to be equipped with three 8,000-hp. vertical-shaft turbo-generators. Of the total available, 16,000 hp. will be the regular output, while the other 8,000 hp. is to be kept in reserve. Energy is to be generated at 6,300 volts, transmitted at 66,000 volts and carried to Haifa and Jaffa on steel transmission towers.

For the future the Palestine Electric Corporation has several projects in view, chief of which are diversion of the Yarmouk River into Lake Tiberias to conserve the floodwaters, deepening of the Jordan to a maximum of 23 ft. from Lake Tiberias to carry the regulated water of both rivers, and construction of a hydro-electric plant at Abadiek.

Briefer News

BATON ROUGE LIGHTS UP.—With elaborate ceremonies, Baton Rouge last week initiated a "white way" in its business district, affording fifteen times the candlepower of the former system and bringing the capital of Louisiana in line with modern ideas of street illumination.

EXPANSION IN RHODE ISLAND.—The Narragansett Electric Company, Providence, one of the leading subsidiaries of the New England Power Association, announces that expenditures in excess of a million dollars have been authorized for improvements. About $500,000 will be expended at the South Street generating station and $600,000 for a new substation to be completed in the fall of next year.

NEW HALF-MILLION-DOLLAR SUBSTATION FOR WESTCHESTER LIGHTING COMPANY OPENED.—Formal opening at Eastchester, N. Y., of a new substation of the Westchester Lighting Company erected at a cost of $500,000 to serve Bronxville, Tuckahoe, Eastchester town and part of Scarsdale, in the suburban area north of New York City, took place on Dec. 8 in the presence of many guests. President E. H. Rosenquest described the growth of the company from a total of about fifty meters in 1900 to more than 100,000 today.

ELECTRICITY SEEKS "WORLD'S DEEPEST" OIL WELL.—Electric power was an essential factor in drilling what is declared to be the deepest oil well in the world, owned by the Texon Oil & Land Company in the Big Lake oil field in Reagan County, Tex. At a depth of 6,573 ft. the drilling equipment of this well was changed to electric power and the hole was then continued to a depth of 8,532 ft. If gas pressure can be brought under control, the well will be drilled still deeper.

WYOMING TOWN GOING ON UTAH POWER LINES.—The town of Evanston, Wyo., is soon to become a part of the Utah Power & Light Company's hydroelectric system. A line, about 40 miles in length, is being built from Devil's Slide, Utah. Evanston, which constitutes one of the geographical divisions of the Utah Power & Light Company's properties, has been receiving service from a steam generating station. This property was acquired by the power company about four years ago.

ALABAMA COMPANY PERMITTED TO TRANSMIT ENERGY INTO TENNESSEE.—The Southern Cities Power Company, operating in northeast Alabama, may transmit electrical energy into Tennessee by the terms of an order issued by the Alabama Public Service Commission on condition that it maintain a meter at the state boundary to record the quantity of energy sent out of the state over a 44,000-volt transmission line. The company was authorized by the commission to construct such a line from a point on its Stevenson-Bridgeport system to the border to connect with a line from Orme, Tenn.

DEVIL'S RIVER GENERATES FIRST ELECTRIC POWER.—On Sunday, Dec. 9, the switches at the Devil's Lake hydroelectric plant on Devil's River near Del Rio, Tex., were closed and the first power generated by the Devil's River was sent on its way, under a 38-ft. head, into the transmission system of the Central Power & Light Company in west Texas. It was anticipated that the full head of 45 ft. would be available by the end of the year with the completion of the upper portion of the dam.

PENNSYLVANIA RAILROAD AND BALTIMORE TRY TO ADJUST DIFFERENCES OVER ELECTRIFICATION.—A proposal from the Pennsylvania Railroad to refer to the arbitration of three experts the issue of overhead or underground electrification of its tracks through the city of Baltimore has not been favorably received by the Mayor's advisory commission. The railroad professes its desire to find some other practicable way than overhead lines to convey power at 132 kv. if such way there be. The city is disposed to insist on the lines going under ground.

DEFECTIVE TURBINE AT SAN ANTONIO SPEEDILY REPLACED.—The San Antonio Public Service Company announces the completion of the 30,000-kw. turbogenerator at the Comal Power Company's plant in that city ahead of schedule. Failure of the 30,000-kw. unit previously installed in that plant led to a rush job on reblading. In the meantime the company's hydro plant, with aid from the Central Power & Light plant at Luling and from the Texas Power & Light plant at Trinidad, in addition to water power drawn from the Guadalupe dams, enabled the company to maintain its usual service.

ELECTRICITY WINS IN DALLAS PUMPING CONTROVERSY.—In a report to the City Commission of Dallas on the relative initial cost and expense of operation of an electrically driven pump at the city's new pumping station at the Bachman Dam and water-storage reservoir and those of a steam plant, Major W. J. Powell, special referee in a long-drawn-out power controversy, recommends the electric installation. He asserts that the use of electricity will not only mean a saving of $300,000 in initial installation costs but an average saving of $4,000 to $5,000 annually in fuel costs.

FIRST STATE APPLICATION FOR VIRGINIA WATER POWER.—The first application under the act of the 1928 General Assembly of Virginia for a license to develop water power will be heard by the State Corporation Commission on Feb. 7. It is the petition of the Virginia-Carolina Power Company for permission to reconstruct and enlarge its development at Boyd's Mill, on the Roanoke River in Mecklenburg County. The company proposes to build a concrete dam and power house and install 30,000 hp. The development will have the advantage of the storage of the Buggs Island project of the Roanoke River Power Company, which is estimated at 5,000,000,000 cu.ft.

ELKINS, W. VA., FLIRTING WITH PLAN FOR MUNICIPAL STREET-LIGHTING PLANT.—Possibility of the establishment of a municipally owned electric plant in Elkins, W. Va., is indicated in the action of the City Council in declining to enter into a contract with the Monongahela-West Penn Public Service Company for the next five years for street lighting and power. In taking such action the Council approves the report of a special committee which has been studying the matter for a year. As an alternative it was indicated that a bond issue might be submitted to the citizens of Elkins at the March municipal election. Only the city's own power is affected, the company holding an unexpired franchise for private service.

MILD WEATHER AIDS LAKE LAMOKA PROJECT.—Because of mild weather construction work on the first stage of the Lake Lamoka power development project in upstate New York is three months ahead of the schedule, according to the contractors for the first stage. The 3,200-ft. penstock of steel and wood from the top of the hill overlooking Lake Keuka to the power house at the water level, has been completed,

Coming Meetings

[A complete directory of electrical associations, with their secretaries, is published in the first issue of every volume. For latest list see issue for July 7, page 48.]

Empire State Gas and Electric Association—Electric Section, United Engineering Societies Bldg., New York, Jan. 10 and 11. C. H. B. Chapin, Grand Central Terminal, New York.

American Engineering Council—Annual meeting, Washington, Jan. 14 and 15. L. W. Wallace, 26 Jackson Place, Washington.

Kentucky Association of Public Utilities—Brown Hotel, Louisville, Jan. 15 and 16. E. F. Kelley, Louisville Railway Co., Louisville.

North Central Electric Association — Engineering Section, Minneapolis, Jan. 21-22; Commercial Section, Minneapolis, Feb. 25 and 26. J. W. Lapham, 803 Plymouth Bldg., Minneapolis.

National Electrical Manufacturers' Association — Supply Division, Hotel Commodore, New York, Jan. 21-26. S. N. Clarkson, 420 Lexington Ave., New York.

American Institute of Electrical Engineers—Winter convention, New York, Jan. 28-Feb. 1; regional meeting, Cincinnati, March 20-22. F. L. Hutchinson, 33 West 39th St., New York.

Midwest Power Conference — Chicago, Feb. 12-16. G. E. Pfisterer, 53 W. Jackson Blvd., Chicago.

New Mexico Utilities Association — Franciscan Hotel, Albuquerque, Feb. 18-20. Bernard L. Wiles, Albuquerque Gas & Electric Company, Albuquerque, N. M.

Oklahoma Utilities Association—Oklahoma City, March 12-14. E. F. McKay, 1020 Petroleum Bldg., Oklahoma City.

more than half of the two-mile canal in the hills is 90 per cent completed, foundations for the power house have been sunk, steel work is in place and the work of pouring the concrete is going forward. From the forebay the water will fall 385 ft. through the penstock to turn the turbines.

FIFTEEN-MILLION-DOLLAR POWER STATION FOR GREAT BRITAIN.—Construction of a power station on the River Severn at Ironbridge, in Shropshire, England, at a cost of $15,000,000, has been approved by the Electricity Commissioners. It is the first section of a project for supplying the Western Midlands with electric power. The plant will be completed in 1930 and the whole project in about twelve years, when Ironbridge will become one of the principal base-load stations for central England.

PATENT EXAMINERS NEEDED.—As applications for patents are being received at the Patent Office at the rate of 8,000 a month, there is a constant demand for competent examiners, and the Civil Service Commission frequently has to make special efforts to maintain adequate eligible lists upon which the Patent Office can draw. Examinations for positions as junior patent examiners now are being held. The entrance salary is $2,000. Students who have had two years of technical and scientific instruction should be able to pass the examination, the commission believes.

WASHINGTON ELECTRIC COMPANY'S COLUMBIA RIVER PROJECT.—Construction of a hydro-electric generating plant to serve Douglas and Chelan Counties, Wash., is contemplated in an application filed with the State Supervisor of Hydraulics by W. H. McGrath for the Washington Electric Company of Seattle. The company seeks to appropriate 24,000 sec.-ft. from the Columbia River for the development of 60,000 hp. to be used for manufacturing purposes, electrical operation of railroads, city lighting and general utility purposes. The project is estimated to cost $8,000,000, and construction of a 1,500-ft. dam will, it is promised, begin Sept. 1, 1929, and be completed by Jan. 1, 1932.

ONLY 75 COMPLAINTS OF RADIO INTERFERENCE RECEIVED BY FEDERAL RADIO COMMISSION IN SIX MONTHS.—In view of the prevalent belief that electric lines interfere greatly with radio transmission, it is suggestive that to only 75 complainers in six months did it occur to write to the Federal Radio Commission. The commission turned the complaints over to the National Electric Light Association, which in turn took them up with the individual light and power operating companies concerned. The association now reports that a majority of the complaints were either from unreasonable persons or from owners of supersensitive receiving sets. The association attributes the great decrease in seriousness of a once-threatening situation to the efforts made by the electric companies themselves to eradicate at once every cause of interference for which they were responsible—one in ten, the association estimates.

PRAGUE FLOODLIGHTED TO CELEBRATE CZECHOSLOVAKIA'S TENTH REPUBLICAN ANNIVERSARY.—The tenth anniversary of the establishment of the Czecho-slovakian Republic was celebrated in Prague, the capital, in October, by the floodlighting and general illumination of historical buildings and monuments, many beautiful effects being achieved. The photograph here reproduced shows the floodlighted statue of Woodrow Wilson, which was erected in Prague

in 1928 by contributions from Czecho-slovakian Americans, in gratitude for the help rendered by the American President in the establishment of the new republic.

OUTSIDE APPLICATION FOR ILLINOIS RIVER SITE IN OREGON MADE TO STATE BOARD.—The Oregon Water Board has received an application from Charles H. Lee and Romaine W. Myers, of Oakland, Calif., asking for authority to store 410 acre-feet of water from the Illinois River and for a permit to use 800 sec.-ft. of this stored water for power development. The Illinois River is in Josephine County, in the extreme southwestern section of Oregon, in territory at present served by the California-Oregon Power Company. The latter is thought likely to be considered as the possessor of prior right.

OHIO POWER COMPANY'S NEW EQUIPMENT AND LINES COSTING MORE THAN $19,000,000.—According to an application made by the Ohio Power Company to the Public Utilities Commission of Ohio to authorize the issue of $13,303,000 in bonds and 44,366 shares of preferred stock to pay for additions and betterments, $9,628,000 in bonds, along with 32,105 shares of preferred stock at $100 par value, will go to pay for the great 165,000-kw. turbo-generator unit under construction at the Philo plant and for the 132-kv. double-circuit transmission line to be erected from Philo, 12 miles south of Zanesville, to Fostoria via Shelby and from Shelby to Alliance and vicinity. The new unit's cost is put at $17,328,000 and the cost of the transmission line at $1,897,120. The new generator will give the Philo plant a total rating of 245,000 kw.

LOWER RATES FOR MANCHESTER AND NASHUA, N. H.—A lower schedule of rates for the Manchester and Nashua districts has been filed with the State Public Service Commission by the Public Service Company of New Hampshire, to become effective Jan. 1. The highest rate now paid for electricity, 11 cents per kilowatt-hour, will be reduced to 10 cents, and it is estimated that the aggregate saving to consumers will be not less than $63,000 a year. The new rate is divided into four steps, 10, 7, 4 and 2 cents, the size of the steps varying with the size of the house. A new commercial lighting rate will be divided into three steps.

PROGRESS MADE ON GOVERNMENTAL ELECTRIC SYSTEM IN SASKATCHEWAN PROVINCE.—The scheme for a province-wide distribution of electrical energy under the auspices of the government of Saskatchewan, Canada, has been advanced by the Saskatoon City Council's approval of a final draft of the power agreement between the city and the provincial government. This will lead to the sale of the municipal power plant to the government and the erection by the latter of a 10,000-kw. plant by next fall from which it will supply Saskatoon and probably a great portion of the surrounding country with electricity. This generating station is expected to become the nucleus of a northern system of distribution of electrical energy in the province.

PACIFIC GAS & ELECTRIC CONTRACT WITH NEVADA IRRIGATION DISTRICT HOLDS.—The Nevada Irrigation District, the second largest in California, has received an initial payment from the Pacific Gas & Electric Company of $190,208 under a 50-year contract between the district and the power company. This payment sets at rest rumors that the contract had been repudiated by the company. It is also stated that a supplemental contract is being prepared between the district and the company which is officially estimated to produce about $85,000 net annually. Revenues received by the district under the agreements are for waters delivered from its mountain division to the power company for use in seven hydro-electric plants.

CLEVELAND ELECTRIC ILLUMINATING COMPANY TO INSTALL A 35,000-KW. GENERATOR AT AVON.—Authorization of a budget of $11,000,000 for improvements and extensions of the Cleveland Electric Illuminating Company's system in 1929 has just been announced. Most

important among the extensions is the installation of two boilers and a turbo-generator of 35,000-kw. rating at Avon station, bringing the installed capacity of this plant up to 140,000 kw. and increasing the total generating capacity of the company's system to more than 450,000 kw. The company's light and power consumers in Cleveland and Northeastern Ohio have increased to approximately 300,000. Its output for 1928 is estimated at 1,325,000,000 kw.-hr.

EAST RIVER STATION'S 160,000-KW. GENERATING UNIT TO BE COMPLETED NEXT FALL.—M. S. Sloan, president of the New York Edison and associated companies, announces the placing of an order with the International Combustion Engineering Company for three boilers of extraordinary size to supply the 160,000-kw. generator which, as previously announced, the General Electric Company has under construction for the East River Station on Fourteenth Street, New York. Delivery of the boilers is expected to start in about four months, and the unit will, Mr. Sloan says, be placed in operation about the first of next September. Details of the steam equipment ordered are printed under "Activities of the Trade" (page 1328).

BIDS EXPECTED NEXT MONTH ON DELAWARE & LACKAWANNA ELECTRIFICATION.—It is authentically reported that bids will be made in January on the Delaware, Lackawanna & Western electrification project covering its main lines out of New York to Dover, N. J., and also suburban branch lines. This electrification is to be 3,000-volt direct current. No decision has yet been made about the sources of power supply, but it is understood that negotiations are being conducted with the Public Service Company of New Jersey and the Insull and Barstow interests in that state and that simultaneous studies have been made as to the costs involved in producing power by means of a railroad power station. Jackson & Moreland are consulting engineers for the railroad in connection with this electrification.

GEORGIA POWER COMPANY MAKES DIFFICULT INSTALLATION IN NEW ATLANTA DISTRICT.—One of the largest projects of its sort ever undertaken in Atlanta was recently completed when officials of the Georgia Power Company turned on the power in the new Pryor Street-Central Avenue area of the city. Eight utility lines were in operation in the area covered by recent viaduct construction, and the task of installing necessary conduits and mains without disturbing existing service presented difficult problems. The power company, in installing power, gas and steam-heat lines, put sufficient building material underground in this area, it is said, to construct a 25-story building. Approximately 23 miles of duct line and 14 miles of cable for electric service were installed without any interruption of service.

Recent Court Decisions

OKLAHOMA "WHITE WAY" IMPROVEMENT DISTRICT UPHELD.—In Bragdon vs. City of Muskogee, the Oklahoma Supreme Court has upheld the right of a city to provide specifically by charter for "white way" improvement districts. The essential element of a local improvement is that it shall benefit the property upon which the costs are assessed in a manner local in its nature and not enjoyed by the property generally in the city. The fact, however, that the local improvement may incidentally benefit the entire city does not destroy its use as a foundation for local assessment. A special provision in the Muskogee city charter which authorizes a special assessment for payment of all benefits for special lighting districts is authorized by the Oklahoma Constitution, the court held.

FIFTEEN YEARS' NON-USE RENDERS WATER RIGHTS VOID.—In the opinion of the United States District Court for Oregon, the abandonment and non-use of a water-power right extending for a period of fifteen years is sufficient ground upon which to declare such right void. This is its finding in California-Oregon Power Company vs. City of Gold Hill and the Beaver-Portland Cement Company, in which it was sought to enjoin the defendants from constructing a power dam over certain property of riparian character along the Rogue River and claimed by the plaintiff utility. The water rights previously acquired by the respondents in this case were issued by the state in 1911, the city of Gold Hill being the original holder of the grant. No active use was made of the rights by the municipality, however, and in 1926 the city disposed of both rights and other utility property to the Beaver-Portland Cement Company for a consideration of $22,600. The latter, in order to extend its electric service, attempted to proceed with the construction of dams and additional power facilities along that portion of the river which was filed upon by the Gold Hill authorities. The court holds that such operations cannot be undertaken, the original water rights having been rendered void by reason of non-use. The restraining order further prevents the Beaver-Portland company from diverting any of the water in a way to prevent its potential use by the California-Oregon Power Company.

COMMISSION HAS NO JURISDICTION OVER STOCK ISSUES OF COMPANY INCORPORATED IN ANOTHER STATE.—Action of the California Railroad Commission in declining to permit the Southern Sierras Power Company to issue $2,000,000 of preferred stock for refunding of outstanding indebtedness, on the ground that the applicant company being a Wyoming and hence a foreign corporation the commission possessed no jurisdiction over its issuance of stock, has been sustained by the California Supreme Court, which said: "While the Legislature has the power to dictate under what terms and conditions foreign corporations may transact business in this state, this power does not extend so far as to give the Legislature the power to regulate or control the *intra vires* act of such corporations concerning their internal affairs. Over such matters it has no power of control. . . . Nor does the fact that a foreign corporation engaged in business within the state is within the jurisdiction of the state courts in suits against it upon its contracts or for fraud practiced in the operation of its business subject it to legislation purporting to regulate the exercise of its inherent powers. . . . For the same reason courts will refuse to exercise visitorial powers over foreign corporations or interfere with the management of their strictly internal affairs. . . . While the term 'internal affairs' is more or less indefinite, there can be no question that the issuance of stock by a corporation is purely an internal affair, and to entertain an action to compel its issuance would clearly constitute the exercise of visitorial powers over the corporation or an interference with the management of its internal affairs. From the very nature of corporate stock, which is created by and under the authority of a state, the right or duty to issue it, like the other attributes of the corporation, is governed by the local laws of the state from which it derives its existence and not by that of any other state."

Commission Rulings

CONTRACTS PREVIOUSLY MADE WITH INDIVIDUAL COMPLAINANTS NOT CAUSE FOR UPHOLDING COMPLAINT AGAINST NEW RATE.—The Borough of Mount Union, Pa., and sundry individuals complained against a new standardizing rate made by the Penn Central Light & Power Company and offered in evidence contracts between the borough and the respondent's predecessor providing for service to individual patrons at rates named therein. No evidence was offered by the complainants as to the reasonableness of either the contract rates or the rates contained in the tariff under complaint. The Pennsylvania Public Service Commission declared that the fact that a contract had been made as to rates to be charged to individual consumers within a borough was not sufficient to warrant the commission in sustaining a complaint, where no evidence was offered as to the reasonableness of the rates involved.

INDIANA COMMISSION MAKES TWO RADICAL RULINGS.—The Indiana Public Service Commission has, through a recent ruling, broken a monopoly on telephone service in the city of Versailles by permitting an outside company to invade that territory. The already established company, which may be joined by other utilities, is expected to make a strenuous fight against this order, which smashes a virtual rule that has stood almost since the establishment of the commission. At the same session the commission issued what amounted to another warning to utilities that "boosting" of valuations might lead to rates which will not make capital outlays so profitable as the owners would desire. This warning was contained in an order establishing for the Eastern Indiana Gas Company in five Indiana cities a rate that will give only 3½ per cent profit to the utility on the investment. The commission's order blames the company for investment increases of more than 50 per cent in the last year without thought of whether the higher rates would be feasible in the community. "It is unfair to make investments in extensions that will necessitate high rates, and the utility must stand a low rate in face of such circumstances," the order said.

News About Men of the Industry

Shaw and Loeb Resign Vice-Presidencies

Phillips B. Shaw and Leo Loeb, vice-presidents of the National Electric Power Company, have resigned to devote their time to other public utility companies in which they have purchased an interest. In association with others they have acquired the properties owned and operated by the United States Electric Power Corporation, an Albert Emanuel organization. Operation and management of these properties will be carried on by the North American Gas & Electric Company, a new company incorporated in Delaware. Mr. Shaw will be president, Mr. Loeb vice-president and treasurer and L. E. Yeager of the United States Electric Power Corporation vice-president, with headquarters in New York. Mr. Shaw has been vice-president in charge of operations for the National Electric Power Company since its inception and Mr. Loeb has been vice-president in charge of new properties, rates, valuations and power business since the Albert Emanuel Company, Inc., of which he was a vice-president, was merged into the National Electric Power Company four years ago.

A. R. ERSKINE, president of the Studebaker Company, has been elected a director of the Electric Household Utilities Corporation.

HENRY I. HARRIMAN, president of the New England Power Company, has been appointed a trustee of the Boston Elevated Railway by Governor Fuller of Massachusetts.

J. LEO WELCH has been appointed assistant engineer in the electric department of the Syracuse Lighting Company, Syracuse, N. Y. Mr. Welch formerly engaged in electrical construction work for the U. G. I. Contracting Company and more recently has served as superintendent of plants for the Syracuse utility.

CHARLES H. KENNEY, formerly distribution engineer for the Brooklyn Edison Company, has joined the Rome Wire Company division of the General Cable Corporation, where he will be occupied in field engineering work in the metropolitan section.

ARTHUR W. THOMPSON, president of the United Gas Improvement Company, has left the East for a trip to the Pacific Coast. Mr. Thompson will visit Cuba, Panama and California. A return trip overland will carry him through the Grand Canyon. After returning to Philadelphia for a short period, Mr. Thompson will sail from New York on Jan. 19 for a Mediterranean cruise on the steamship *Laurentic*. He will return to Philadelphia March 7. Because of impaired health, he was recently granted a six months' leave of absence by the board of directors. Continued improvement has been noted in Mr. Thompson's condition in the last two weeks.

Ernsberger Relinquishes Duties in Oklahoma City

Earl R. Ernsberger, president and general manager of the Southwestern Light & Power Company, has resigned to devote his entire attention to his personal oil and agricultural interests in Texas and Oklahoma. When Mr. Ernsberger assumed executive charge of the Southwestern Cities Electric Company, the predecessor of the Southwestern Light & Power Company, in 1922, he had already established a reputation for progressive and efficient management in the public utility field. In 1913 he became identified with the Charles City (Iowa) Western Railway Company as vice-president and general manager. This was a losing property, but during his management it was electrified and put on a paying basis and was operating as such when he removed to Oklahoma.

E. R. Ernsberger

A graduate civil engineer, Mr. Ernsberger entered the employ of the Pennsylvania Railroad Company, at Pittsburgh, Pa., later transferring his interests to Cleveland as assistant to the chief engineer of the Wheeling & Lake Erie Railroad. He first became connected with electrical operations through the electrification of the Northwestern Elevated Railroad in Chicago and he entered the electric light and power industry as chief engineer and general manager of the Mount Hood Railway & Power Company, Portland, Ore. Mr. Ernsberger has been a member of the executive board of the Oklahoma Utilities Association for three years and was president of the association last year. His interest and co-operation in the work of the association before, during and subsequent to his term as president have been without limits.

R. T. PORTER, for the past year superintendent of operations in the Dublin district of the Georgia Power Company, has been appointed assistant manager of the new Macon division of the company. Mr. Porter is a graduate of the Alabama Polytechnic Institute and was formerly identified with the Alabama Power Company.

NELSON L. MANTER has been appointed farm service engineer for the Central Maine Power Company. His chief duties will be to build up the load on farm service extensions. Mr. Manter is well equipped to pursue this type of work, having been brought up on a farm and later taking agricultural courses while attending college.

HENRY R. STEVENS, formerly connected with Thebo, Starr & Anderton of San Francisco, has opened a consulting engineer's office in Seattle, associated with Miles E. Clark, formerly assistant chief engineer with the Public Service Commission of the State of Washington. Mr. Stevens will specialize in design and construction of steam and hydro-electric developments and valuation and rates of public utilities.

LEONARD D. DENSMORE, for the past two years secretary of the Nebraska State Railway Commission, has resigned to become assistant counsel for the Central West Public Utilities Company of Omaha, of which Frank J. Milhollan, for ten years chairman of the North Dakota Commission, is president. Mr. Densmore is succeeded by Hugh M. Drake of Kearney as commission secretary.

FRANK BOLSTER, formerly engineer in the electrical department of the Syracuse Lighting Company, has joined the staff of the Rome Wire Company division of the General Cable Corporation as supervisory engineer. Mr. Bolster will be located at Rome and will devote his time to engineering work in connection with the application of this company's product in the central-station field.

W. R. DIXON, formerly supervisor of industrial sales New York Power & Light Corporation, Albany, has been appointed division engineer of the Capitol division with headquarters in Albany. Mr. Dixon became identified with the New York Power & Light Corporation in the spring of this year, after severing his connection with the Florida Public Service Company, where he was general superintendent, having headquarters at Orlando. Formerly he served the Piedmont Power & Light Company as president and general manager, and when this company was sold he became manager of the same section under the North Carolina Public Service Company. Mr. Dixon has also served the Kentucky & West Virginia Power Company and the Cutler-

Hammer Manufacturing Company at Milwaukee, Wis. He is a graduate of Virginia Polytechnic Institute and a member of the American Institute of Electrical Engineers.

JAMES R. KOCH, who for the past five years has been distribution engineer for the Pennsylvania Electric Company, Johnstown, Pa., is now chief engineer of the Manila Electric Company.

HON. J. L. PERRON, minister of roads for the Province of Quebec, has been elected a director of the Shawinigan Water & Power Company to fill the vacancy created by the death of R. W. Kelly of New York. Mr. Perron is also a director of United Securities, the Montreal Tramways Company, the Canada Cement Company, and several other industrial corporations.

MAJOR JAMES R. WERTH has just been appointed commercial manager for the State of São Paulo, Brazil, for the Empresas Electricas Brasileiras, São Paulo, an Electric Bond & Share property. He was formerly head of the new-business division of the Florida Power & Light Company, also a subsidiary of the Electric Bond & Share Company.

J. H. DUNLAP, formerly sales manager of the Missouri Public Service Company at Warrensburg, Mo., has been appointed commercial manager for all the properties of the company. JOHN CROSS, who has been in the service department of the Warrensburg office, has been selected to succeed Mr. Dunlap as local sales manager.

R. L. GRISSOM, manager of the Natchez properties of the Southwestern Gas & Electric Company, will head the Natchez Association of Commerce as president for 1929, the nomination having been accepted in the report of the nominating committee presented at the recent directors' meeting. Mr. Grissom has shown keen interest not only in the affairs of the Association of Commerce but also has assumed leadership in all civic enterprises.

EDWARD F. KELLY has been appointed executive manager of the Central Illinois Public Service Company, Springfield, in charge of safety, public relations and the commercial department. Mr. Kelly enters upon his new duties with an unusual background of utility operative experience. A graduate of the Massachusetts Institute of Technology, he entered the employ of the New York Edison Company and served for a period of four years as power salesman before being appointed assistant manager of the power department. In 1913 he became identified with the Central Illinois Public Service Company as power salesman and not long afterward became assistant manager of the commercial department. After spending three years in this position he was transferred to the Twin State Gas & Electric Company as commercial manager, and the performance of these duties was relinquished when he entered military service. Following his discharge he re-entered the employ of the Central Illinois Public Service Company as division manager at Mattoon, the position he was holding at the time of his recent promotion.

B. R. CHESTNEY of Macon has been named manager of the Macon division of the Georgia Power Company. Mr. Chestney became acting manager of the Macon utilities some months ago, when L. A. Magraw, vice-president and general manager, affiliated himself with the South Carolina Power Company in an official capacity. The consolidation of the three public service corporations operating in Macon with the Georgia Power Company became effective Dec. 1, when a new charter was issued by the Secretary of State.

H. H. DEWEY of Schenectady has been appointed vice-president of the International General Electric Company, Inc., according to an announcement made by President Clark H. Minor. Mr. Dewey has been assigned supervision of all interests of the company in connection with Russian business. As assistant engineer of the central-station department of the General Electric Company, Mr. Dewey was called upon to go to Russia in 1927 and again in 1928 on plans for public utility developments in that country.

FRANK E. BOYD, for 23 years connected with the General Electric Company and for sixteen of those years manager of motor sales of the industrial department in the San Francisco office, has resigned to become a partner in the Pacific Electric Motor Company and the Resilient Terminals Company of Oakland, Calif. His greatest work has been in the building up of systems of motor agents, and developing the motor business with the larger manufacturers. He has been a pioneer in the electrification of agriculture and is a member of the California State Committee on the Relation of Electricity to Agriculture. In addition he has been a director of the San Francisco Electrical Development League and the Pacific Coast Electrical Association.

Obituary

O. B. VINAL, superintendent of the department of turbine inspection for the General Electric Company in the New England States, died recently at his home, in Boston, Mass. Mr. Vinal had been connected with the General Electric Company for the past eleven years and was well known in its engineering department.

GEORGE L. RIGGS, president of the Standard Electric Time Company, Springfield, Mass., manufacturer of synchronized electric clock systems, electric fire alarm systems, systems for delivering and measuring electric energy used in school laboratories and classroom demonstrations, and other electrical equipment, died in Springfield, Dec. 20, after a short illness. He was 54 years old. Mr. Riggs entered the employ of the Standard Electric Time Company at the age of 20 and purchased the company's assets in 1895.

JAMES A. LEROY, assistant to the superintendent of the central division of the Public Service Electric & Gas Company, Newark, N. J., and formerly superintendent of the Elizabeth district, died Dec. 19 of heart disease. His age was 46. Mr. Leroy was born in Alpena, Mich. He started his career with the United Electric Light & Power Company of New York as a meter reader in 1898 and in 1900 he went to the Manhattan Elevated Railway as a wireman when it changed from steam to electricity.

FRANK C. WAGNER, president of the Rose Polytechnic Institute, was killed by an automobile Nov. 21. Dr. Wagner had been president of the Institute since 1923. Though early in his career he spent three years in the employ of the Thomson-Houston Electric Company as erecting engineer, he devoted his time essentially to academic work. From 1890-1896 he was assistant professor of mechanical engineering at the University of Michigan, associate professor of steam and electrical engineering at Rose Polytechnic Institute from 1896-1904 and from that date to his election as president he was professor of steam engineering and associate professor of electrical engineering there.

OSCAR F. LACKEY, who for a time served as vice-president and general manager of the Colorado Springs Light, Heat & Power Company, and who recently was appointed chairman of the Maryland State Roads Commission, died at his home near Baltimore Dec. 19 as the result of pneumonia. He was 54 years of age. After engaging in various engineering enterprises Mr. Lackey became connected with the Colorado company in 1922, later severing his connection with that utility to transfer his interests to Philadelphia. From 1924 to 1927 he was head of the Baltimore Bureau of Transportation and then took up consulting engineering work in Baltimore. He was about to assume his duties as chairman of the State Roads Commission when he died.

RICHARD M. KERSCHNER, who had been associated with Hubbard & Company for the past sixteen years, died Dec. 8 at his home in Zelinople, Pa., after a short illness. Upon leaving school Mr. Kerschner obtained a position with the old Chicago Edison Company, with which he remained until 1900, when he joined the sales force of the Union Electric Company of Pittsburgh. In 1914 he joined the sales department of Hubbard & Company, later becoming sales manager. In 1924 he supervised the building of the new Hubbard factory at Oakland, Calif., remaining in charge there until 1927, when he returned to Pittsburgh to assume charge of the department of development and research, in which position he was active up to the time of his death. He had a host of friends among the central-station men of the country.

Financial and Statistical News

Renewed Interest Appears in Bond Buying

Bond sales on the New York Stock Exchange were substantially heavier in volume during November than in October and they showed a 25 per cent increase over September of this year, according to the current quarterly bond review recently issued by Halsey, Stuart & Company. "Further indications of renewed interest in bond buying," the report says, "is the fact that the investment market of 1928 to date appears to have absorbed more bonds than it did during the corresponding period in 1927. Although the new-capital bond offerings of the first ten months in 1928 were less in volume by $750,000,000 than in 1927, careful estimates indicate that the market also absorbed something over $800,000,000 which the banks liquidated from their reserves during the July-September stringency period. Individual investors and institutions without the help of the bank purchases, therefore, seem to have bought more bonds this year by from fifty to a hundred million than were absorbed last year, when the banks were also buying heavily. Furthermore, according to investment statistics of 600-odd banks which report weekly to the Federal Reserve Board, liquidating on the part of these banks ceased about the first of October, and since Nov. 1 they have been buying bonds steadily. This, of course, indicates that a new demand has re-entered the bond market, which should prove a supporting factor to bond prices.

Merger of Bond and Share Companies Rumored

Rumors of the impending consolidation of the Electric Bond & Share Company and the Electric Bond & Share Securities Corporation persist, although not yet confirmed by officials of the companies. The accepted view seems to be that consolidation of the two would be a normal procedure and current press reports go so far as to outline the probable dividend policy of the merged organization.

The occasion of the formation of Electric Bond & Share Securities and the background of the two companies suggest grounds for the current rumors. About four years ago the General Electric Company, which had up to that time controlled the Electric Bond & Share Company, turned over its holdings of all the outstanding $25,000,000 common and of 300 shares of preferred stock of Electric Bond & Share Company to a new corporation, the Electric Bond & Share Securities Corporation, which was formed as a vehicle for distributing General Electric's holdings in Electric Bond & Share Company to General Electric stockholders. The capitalization of the new corporation consisted of 1,802,870 shares of no-par capital stock, one share of which was distributed for every share of the 1,802,870 shares of General Electric common stock then outstanding. Since the above distribution was made, the Electric Bond & Share Company has been operated as a separate organization, quite independent of its former owner. It was understood at the time the new corporation was formed that it was merely temporary and would probably be retired or merged with the original company after some time had elapsed.

The impression current in financial circles is that one of these two holding companies is adequate to the needs of the system. The question arises, which is likely to be retired. The charter of the newer company is apparently much more flexible than the old, and expansion under an inflexible charter is hampered.

The Electric Bond & Share Securities Corporation owns all of the 500,000 shares of $100 par value common stock of the Electric Bond & Share Company. The latter company has outstanding $50,000,000 of 6 per cent cumulative preferred stock, of which 300 shares are owned by the Securities Corporation. In turn, the Securities Corporation has outstanding 3,205,088 shares of no-par value capital stock. The Securities Corporation has no bonds or preferred stock outstanding.

Niagara Falls Power Group Petition to Consolidate

PLANS for the consolidation into one operating unit of the group of power companies serving the Niagara Falls area have reached the stage of a petition to the Public Service Commission. The application was made by Paul A. Schoellkopf, president of the Buffalo, Niagara & Eastern Power Corporation, last week.

Under arrangements already made, the new company, which will be known as the Niagara Power Corporation, will exchange its securities for those of the existing companies, including the Buffalo General Electric Company, the Niagara Falls Power Company, the Niagara, Lockport & Ontario Company, the Tonawanda Power Company and their subsidiaries. The company will continue to operate as at present, with a consolidation of its engineering departments and a complete simplification of capital structures. It is anticipated that substantial economies will arise from engineering and financial unification.

The capital set-up of the proposed Niagara Power Corporation tentatively calls for 1,000,000 shares of no-par first preferred stock with cumulative dividends of $5 a year; 2,800,000 shares of $25 par second preferred with cumulative dividends of $1.60 a year; 2,000,000 shares of no-par class A stock, and 2,500,000 shares of no-par common. Privileges and rights accruing to each class of stock in Buffalo, Niagara & Eastern Power Corporation will accrue to stock of same name in new corporation. It is proposed to exchange Buffalo, Niagara & Eastern stock share for share for a stock in new company. A stockholders' meeting to approve the plan is to be called in the near future.

In the statement which accompanied the application for permission to consolidated Mr. Schoellkopf states that the consolidation of companies will facilitate operations of several plants and will assist in the financing necessary to provide for improvements and extensions. Power companies included in in the consolidation serve eighteen counties in western New York. They operate hydro-electric plants with a total capacity of 735,000 hp. and steam plants with capacity of 353,000 hp. and have distributing systems in Buffalo, Niagara Falls, Lackawanna, Jamestown, the Tonawandas and 250 other communities.

The filing of the application for consolidation marks the end of the first step in the unification program, which has been under way for more than a year. All of the companies to be brought into the new company are at present subsidiaries of the Buffalo, Niagara & Eastern Power Corporation or its subsidiaries, which collectively holds assets of more than $210,000,000.

Two New Utility Offerings Made

During the last week of December two new offerings of electric light and power securities were made, one by the Wisconsin Power & Light Company, and the other by the North Boston Lighting Properties. The Wisconsin issue was in the form of first lien and refunding mortgage 5 per cent gold bonds, series F, a piece of financing involving a total of $2,500,000. These bonds, priced at 100 and interest, will, together with all other bonds issued under the mortgage, be secured by a first mortgage on important divisions constituting approximately 45 per cent of the value of all properties now owned by the company and will be

further secured by a direct mortgage lien on the remaining property, right and franchises of the company now owned or which may be hereafter acquired, subject to $12,153,000 in principal amount of divisional bonds now outstanding and by mortgages which have been closed, and subject as to hereafter acquired property, to liens existing thereon at the time of acquisition.

The North Boston Lighting Properties issued three-year 5 per cent gold notes to the amount of $3,500,000 at 99¼ and interest, to yield 5.27 per cent. These notes, dated Jan. 2, 1929, mature Jan. 2, 1932.

Utilities Power & Light to Increase Capital Stock

A special meeting of the stockholders of the Utilities Power & Light Corporation has been called for Jan. 10 for the purpose of increasing its capital stock. The change in set-up involves class A and class B common stock, both of which will be increased from 1,000,000 to 5,000,000 shares of no par value. In commenting on the proposed change Harley L. Clarke, president, said: "We are merely preparing for the future requirements of the corporation, as, with the desired authority granted, we will be in a better position to acquire additional properties here and abroad as favorable opportunities are presented to us. The company has added materially to its foreign investments during the year and has plans for further acquisition in this field. Still another important consideration, I believe, is that this would permit the Utilities Power & Light Corporation to eliminate its funded debt and preferred stock, leaving a simplified capital structure with nothing more than common stock, A and B."

Light and Power Revenue $165,200,000 in October

7,527,273,000 Kw.-Hr. Generated—Energy Increased 14 per Cent, Revenue Increased 9.6 per Cent

OCTOBER returns to the ELECTRICAL WORLD giving data on electric light and power companies throughout the United States clearly indicate a continuation of the accelerated rate of operations observed during several preceding months.

The revenue, estimated for the entire industry at $165,200,000, was 9.6 per cent greater than in October, 1927, nearly 5 per cent greater than in September and more than 12 per cent over that of the low month of the summer, July. The energy output, 7,527,273,000 kw.-hr., exceeded that of the corresponding month last year by more than 14 per cent, breaking all records. It was 9 per cent greater than in September and more than 13 per cent greater than in June, the summer's low month.

The increase by regions is shown in the following table:

Region	Per Cent Increase Compared with October, 1927	Per Cent Increase Compared with September, 1928
New England	9.0	9.2
Atlantic	9.2	5.2
North Central	8.3	1.5
South Central	14.0	6.3
Western	11.3	1.2

Operating expenses, $69,500,000, show show a rise of less than 7 per cent com-

Table I—Central-Station Financial Operations for Four Months in the United States

(100 Per Cent of the Industry)

Month	Total Gross Revenue from Sale of Energy†			Estimated Distribution of Gross Revenue								Total Operating and Maintenance Expenses‡	
				Lighting Customers		Power Customers		Electric Railways		Other Public Utilities			
	1928 Thousands	1927 Thousands	Per Cent Inc.	1928 Thousands	1927 Thousands	1928 Thousands	1927 Thousands	1928 Thousands	1927 Thousands	1928 Thousands	1927 Thousands	1928 Thousands	1927 Thousands
July	$146,600	$134,300	+9.2	$78,100	$72,100	$53,000	$47,250	$4,600	$4,320	$10,900	$10,630	$64,100	$62,400
August	148,200	135,600	+9.3	80,100	74,800	52,750	47,400	4,500	4,100	10,850	9,300	66,400	64,100
Sept.	156,100	144,400	+8.1	82,800	78,200	57,300	50,400	4,600	4,400	11,400	11,400	65,500	64,100
Oct.	165,200	150,800	+9.6	89,400	83,100	59,400	51,800	4,800	4,500	11,600	11,400	69,500	65,100

†Aggregate gross revenue from actual consumers, and sales to other public utilities for resale, involving a certain amount of duplication.
‡Do not include interest, taxes, depreciation or sinking fund.

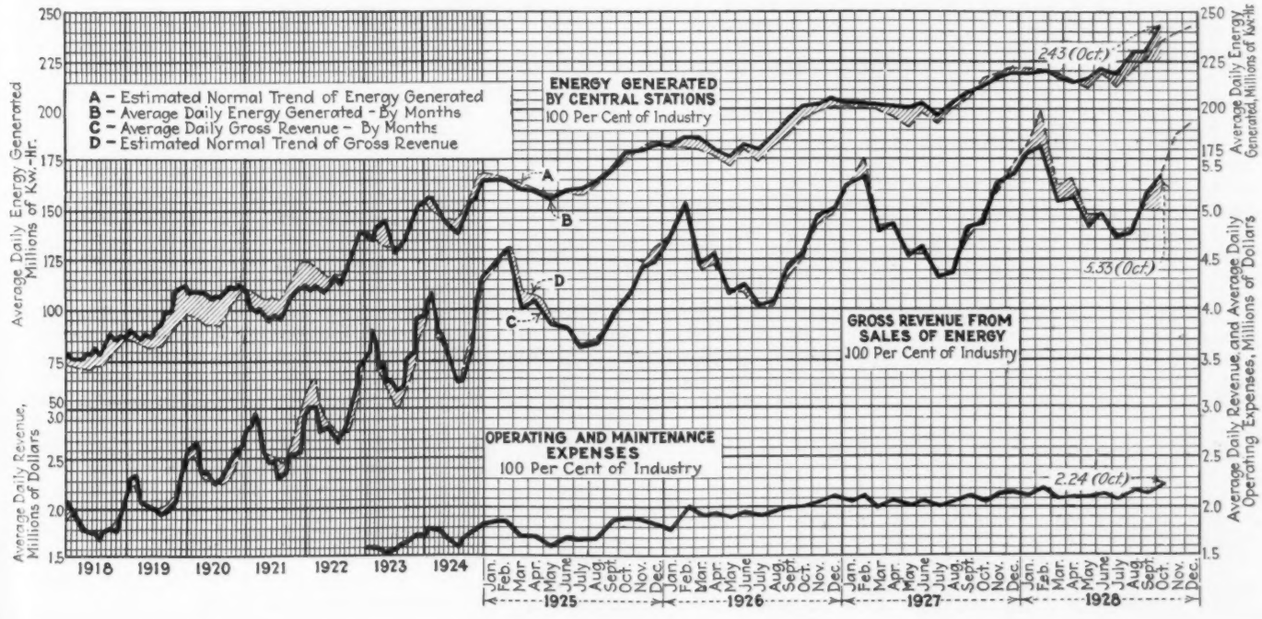

A – Estimated Normal Trend of Energy Generated
B – Average Daily Energy Generated – By Months
C – Average Daily Gross Revenue – By Months
D – Estimated Normal Trend of Gross Revenue
ENERGY GENERATED BY CENTRAL STATIONS
100 Per Cent of Industry
GROSS REVENUE FROM SALES OF ENERGY
100 Per Cent of Industry
OPERATING AND MAINTENANCE EXPENSES
100 Per Cent of Industry
243 (Oct.)
5.33 (Oct.)
2.24 (Oct.)
Average Daily Energy Generated, Millions of Kw.-Hr.
Average Daily Revenue, Millions of Dollars
Average Daily Energy Generated, Millions of Kw.-Hr.
Average Daily Revenue and Average Daily Operating Expenses, Millions of Dollars
1918 1919 1920 1921 1922 1923 1924
1925 1926 1927 1928

Table II—Generation and Distribution of Central-Station Energy in the United States

(100 Per Cent of the Industry)

Month	Kw.-Hr. Generated Monthly *			Estimated Distribution of Energy Generated										Energy Purchased by Public Utilities for Resale, Kw.-Hr.	
				Total Energy Consumption by Central-Station Customers, Kw.-Hr.		Energy Consumed for Lighting, Kw.-Hr.		Energy Consumed for Power, Kw.-Hr.		Energy Sold to Electric Railways, Kw.-Hr.		Energy Used in Intracompany Business, Including Line Losses, Kw.-Hr.			
	1928 †Thousands	1927 Thousands	Per Cent Inc.	1928 Thousands	1927 Thousands	1928 Thousands	1927 Thousands	1928 Thousands	1927 Thousands	1928 Thousands	1927 Thousands	1928 Thousands	1927 Thousands	1928 Thousands	1927 Thousands
July..	6,762,443	6,109,472	+10.7	5,567,443	5,028,472	1,330,000	1,242,000	3,762,443	3,338,472	475,000	448,000	1,195,000	1,081,000	1,246,900	1,178,000
August	7,127,816	6,335,335	+12.5	5,868,816	5,217,335	1,355,000	1,265,000	4,033,816	3,500,335	480,000	452,000	1,259,000	1,118,000	1,291,000	1,290,000
Sept..	6,926,539	6,222,002	+11.3	5,701,539	5,121,002	1,367,000	1,274,000	3,869,539	3,410,002	465,000	437,000	1,225,000	1,101,000	1,270,000	1,220,000
Oct...	7,527,273	6,577,566	+14.4	6,195,273	5,413,566	1,470,000	1,372,000	4,220,273	3,565,566	505,000	476,000	1,332,000	1,164,000	1,360,000	1,290,000

*Data on "energy generated" are those collected and published by the United States Geological Survey for all public utilities minus such data as are collected on energy generated by electric railway companies, reclamation service and manufacturing plants. The data are, therefore, for the electric light and power industry only.
†1928 figures are only approximately comparable with those for 1927, because of changes in classification of certain plants.

*Table III—Operations of Central-Station Hydro and Fuel Plants in the United States**

(100 Per Cent of the Industry)

Month	Energy Generated						Fuel Consumption								
	Hydro-Plants			Fuel Power Plants			Coal			Oil			Gas		
	1928 Thousands of Kw.-Hr.	1927 Thousands of Kw.-Hr.	Per Cent Increase	1928 Thousands of Kw.-Hr.	1927 Thousands of Kw.-Hr.	Per Cent Increase	1928 Short Tons	1927 Short Tons	Per Cent Increase	1928 Barrels	1927 Barrels	Per Cent Increase	1928 Thousands of Cubic Feet	1927 Thousands of Cubic Feet	Per Cent Increase
July.....	2,977,413	2,401,852	+24.0	3,785,030	3,707,620	+0.2	2,878,022	2,996,291	—3.9	530,812	449,903	+18.0	6,962,322	5,598,713	+24.4
August...	2,949,089	2,371,572	+24.4	4,178,727	3,963,763	+5.4	3,146,368	3,180,358	—1.1	589,618	480,022	+22.9	7,653,800	6,259,785	+22.2
Sept.....	2,709,488	2,191,325	+23.6	4,217,051	4,030,677	+4.6	3,138,025	3,183,450	—1.4	582,187	482,363	+20.8	7,242,729	6,466,951	+12.0
Oct.....	2,799,222	2,350,030	+19.1	4,728,051	4,227,536	+11.9	3,518,272	3,332,729	+5.6	621,007	483,554	+28.4	7,782,271	6,424,859	+21.2

*As collected by United States Geological Survey. The data are for the electric light and power industry only.

pared with last year, with a growing margin, therefore, between income and outgo.

Of the energy output, 63 per cent was generated from fuel and 37 per cent from water power. As in other recent months a more than proportionate share of the growth came from water power. The increase from this source has for several months ranged in the vicinity of 20 per cent or more over that of the corresponding months of 1927.

While the revenue during the latter part of 1927 and the first five months of 1928 fell somewhat below the estimated normal, it has been virtually up to or slightly above normal during the succeeding months beginning with June. October was no exception.

The energy output has, during every month beginning with last May, materially exceeded the figure that might have been expected on the basis of growth during the past five years.

Preliminary reports indicate no abatement in November of the favorable conditions here recorded for October.

Northern States Power Issues Rights

H. M. Byllesby & Company announces that the board of directors of the Northern States Power Company has authorized the issuance of additional class A common stock to the extent of one-sixth of the aggregate amount outstanding at the close of business Jan. 7, 1929. Holders of the class A common stock of record Jan. 7, 1929, will be given the privilege of subscribing to this additional stock at $100 a share to the extent of one-sixth of their holdings at that time. The subscription privilege will expire Feb. 7, 1929.

Cleveland Utility Changes Set-up

Stockholders of the Cleveland Electric Illuminating Company at a special meeting Jan. 9 in Cleveland will vote on the board's recommendation, adopted Dec. 20, to increase the authorized no-par common stock to 3,000,000 shares, change the outstanding 166,298 no-par common shares to 1,662,980 and change the outstanding 8,000 shares of preferred stock, authorized 1892 and 1897, to 40,000 no-par common shares.

The Cleveland Electric Illuminating Company is associated with the North American Company. The action recommended by the board will give holders of common stock ten shares for one and will eliminate the 8,000 shares of preferred authorized in 1892 and 1897, giving the holders five shares of no-par common for one of preferred. The effect of eliminating this preferred stock will be to improve the position of the 6 per cent preferred stock, authorized in 1923, by making the latter the senior stock issue of the company. This stock is held widely by the company's customers.

After the contemplated action there will be outstanding 1,702,980 of the 3,000,000 common shares to be authorized. This will leave 1,297,020 shares to provide for future capital requirements. The change involves no increase in the capital liabilities.

A balance sheet giving effect to the proposed increase in the number of shares will show 1,702,980 no-par common shares, having a stated value of $34,059,600; $15,281,700 par value of 6 per cent preferred stock authorized 1923; funded debt of $45,000,000, and surplus of about $5,000,000.

The regular quarterly dividend of 2.5 per cent on the outstanding common stock, payable Jan. 15 to stockholders of record Dec. 31, was declared.

Increased Energy Production Reflects Industrial Activity

The acceleration in industrial activity is clearly reflected in recent statistics on electrical energy production. Data for the entire country collected by the U. S. Geological Survey show an output for October 14 per cent greater than for the corresponding month of 1927. In individual instances this is of course exceeded. Thus Tacoma, Wash., reports an increase of 16 per cent. Coming into the present month the American Gas & Electric Company reports for the week ended Dec. 15 an increase of 16 per cent over the corresponding week last year.

STANDARD GAS & ELECTRIC INCOME UP. — Consolidated earnings of the Standard Gas & Electric Company and subsidiary and affiliated companies for the twelve months ended Sept. 30, 1928, showed a balance of $9,029,277 available for the common stock, after all prior charges, including retirement reserve and preferred dividends. This is equal to $6.36 a share on the outstanding common stock and compares with a balance of $8,275,031, or $5.83 a share, for the twelve months ended Dec. 31, 1927. After payment of dividends amounting to $4,840,595 for the twelve months ended Sept. 30, 1928, there remained a balance of $4,188,682, as compared with a balance of $3,888,471 after payment of common dividends amounting to $4,386,560 for the twelve months ended Dec. 31, 1927.

Business News and Market Conditions

Record Productive Operations During November

Production in Electrical Manufacturing Plants Takes New Upward Turn—Eleven Months' Production 6.5 per Cent Over Same Period in 1927

DURING November the electrical manufacturing plants of the nation as indicated by the consumption of electrical energy was by far the highest on record, after adjustment is made for the number of working days in the month. November rate of operations was 6.8 per cent above that of October, 12.3 per cent over November last year and 4.2 per cent over the previous high mark in rate of activity set during last September. The average rate of operations for the first eleven months of the year was 6.5 per cent over that during the same period last year. This is the first time in two years that an upward turn in operations was witnessed during November.

The index of activity in the electrical manufacturing industry based on the consumption of electrical energy stands at 146.4 in November, as compared with 137.1 in October and 130.4 in November last year. Comparative indexes of productive activity for the period 1923-25 as 100 and adjusted for number of working days are as follows:

November, 1928	146.4
October, 1928	137.1
September, 1928	140.5
August, 1928	119.4
November, 1927	130.4
Average first eleven months 1928	126.7
Average first eleven months 1927	119.0

American industry in general closes a twelvemonth period which has been without question economically in many ways the most outstanding period in its history, and the future is faced with confidence almost unanimous. The year just closed has witnessed record operations in almost every manufacturing group, especially during the last half of the year. General construction has exceeded 1927 by over 14 per cent; general employment has reached record proportions; the average weekly earnings of wage earners at the close of the year was the highest since 1920; corporation earnings advanced materially over 1927; retail trade exceeded the year previous by a wide margin, and the purchasing power of the American people, both urban and rural, was substantially increased. The year ended with industrial and general business activity above the estimated normal conditions, which condition has been maintained practically throughout the year.

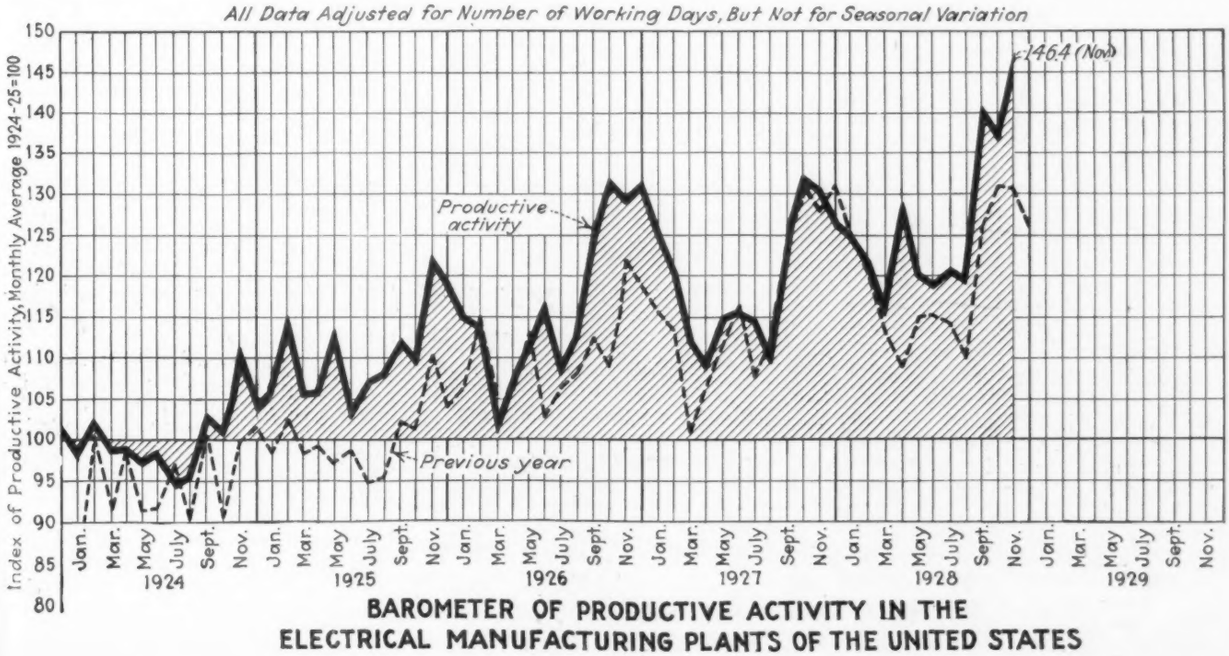
One Big Electrical Congress

THE following suggestion has been sent by Augustus B. Curtis, president of Curtis Lighting, Inc., to the presidents of eighteen national electrical associations: "I propose that all national electrical associations seriously consider holding their annual conventions and exhibitions next year at the same time and place, thus bringing together all members of the electrical family to their mutual advantage, and at such meeting that these associations be merged into one national electrical association. The resulting benefits would be increased attendance, more harmonious co-operation between all groups, great saving of time and gratifying reduction in the enormous expenditure under the present system."

Preliminary Tariff Hearings Early in New Year

The electrical manufacturing industry, acting under the guidance of the tariff committee of the National Electrical Manufacturers' Association and with the co-operation of that association, has evidenced a quick response to the recently issued notice of general tariff hearings to be conducted by the House committee on ways and means prior to tariff revision. The preliminary hearings, arranged under a system of product schedules, will be held from Jan. 7 to Feb. 25, 1929.

The individual sections of N.E.M.A. are filing figures with the tariff committee showing the percentage of cost—not in dollars—represented by labor, material and overhead.



BAROMETER OF PRODUCTIVE ACTIVITY IN THE ELECTRICAL MANUFACTURING PLANTS OF THE UNITED STATES

Delinquent Electrical Accounts

(Data Supp ied by National E'ectrical Credit Association)

Division	November 1927	November 1928	Per Cent Increase or Decrease	Eleven Months 1927	Eleven Months 1928	Per Cent Increase or Decrease
New York	219	207	—5.48	3,355	3,147	— 6.2
Middle and Southern Atlantic	177	134	—24.3	1,862	2,059	+10.6
New England	164	126	—23.1	1,716	1,442	—15.9
Pacific Coast	26	6	—76.9	195	131	—32.8
Central	700	634	— 9.43	9,717	8,184	—15.8
Total	1,286	1,107	—13.9	16,845	14,963	—11.2

TOTAL AMOUNTS REPORTED

	November 1927	November 1928	Per Cent Increase or Decrease	Eleven Months 1927	Eleven Months 1928	Per Cen Increas or Decreas
New York	$29 476	$34,260	+16.2	$517,544	$456,156	—11.8
Middle and Southern Atlantic	17,118	16,280	— 5.25	223,182	264,031	+ 18.3
New England	20,516	17,272	—15.8	203,697	181,694	—10.8
Pacific Coast	3,012	703	—76.6	23,340	17,832	—23.5
Central	78,236	79,282	+1.34	1,070,081	968,345	—9.51
Total	$148,358	$147,737	—0.41	$2,037,844	$1,888,058	—7.35

AVERAGE AMOUNTS

	November 1927	November 1928	Eleven Months 1927	Eleven Months 1928
New York	$135	$165	$1,698	$1,617
Middle and Southern Atlantic	97	121	1,332	1,407
New England	125	137	1,306	1,390
Pacific Coast	115	117	1,589	1,335
Central	112	125	1,223	1,299

The labor item, as explained by Thomas Allen, chairman of the N.E.M.A. tariff committee, should include all wages and salaries, not only direct and indirect in the factory, but also in the selling and administrative departments. It should include commission to salesmen.

The material item should include the cost of all raw materials delivered at the factory, both those entering directly into the article produced and indirect materials, such as fuel, gas, electricity for producing power, heat and light.

Overhead covers the balance of the gross cost, including such items as rents, interest, depreciation, taxes, insurance and all items that cannot be properly classed as labor or material.

Mr. Allen also pointed out that the amount of import duty necessary to equalize the selling prices of imported products with those manufactured in this country depends chiefly upon the percentage of the total cost represented by labor since raw material costs do not vary greatly in the different countries.

Under the present tariff law, the foreign valuation basis is used. Duty is assessed on the basis of the wholesale market value of the product in the country of origin. This phase of the tariff act of 1922 has introduced considerable difficulties for the electrical manufacturing industry. It is felt that the American valuation system, which has for its basis the wholesale market value of the material in the United States, would be fairer to all concerned.

Market Conditions

THE year closses with industrial activity keeping well up to the high levels of the past two months and with predictions of satisfactory volume for at least the early months of 1929. Industry leaders appear quite satisfied with the outlook.

Throughout the East power company requirements feature the week's business. Volume is substantial, especially in New England, where central-station equipment orders exceeded $600,000.

Holiday trade is reported as very satisfactory in most parts of the Middle West and St. Louis districts. Taking of inventories has slowed up business this week, however. On the Pacific Coast power company business is the feature. Orders have been substantial for conduit, cable, poles and insulators.

Copper Sales Break Record Again

The behavior of the copper market during 1928 has induced the use of many superlative descriptive terms, but in none of its various phases has the situation been more astounding than during the last week, covering the holiday period. Following several weeks of inactivity the copper market came to life Jan. 19. Featured by active buying on the part of one or two of the leading consumers the desire for copper became contagious and all buyers quickly decided that they could use a little more copper also, resulting in a new sales record and a ¼ cent advance. Except for the activity in copper, the nonferrous metal markets have been very quiet, though there has been no indication of price weakness.

NEW YORK METAL MARKET PRICES

	Dec. 19, 1928 Cents per Pound	Dec. 26, 1928 Cents per Pound
Copper, electrolytic	16	16.25
Lead, Am. S. & R. price	6.50	6.50
Antimony	9.8125	9.673
Nickel, ingot	35	35
Zinc, spot	6.70	6.70
Tin, Straits	49.50	49.875
Aluminum, 99 per cent.	24.30	24.30

Base copper wire price Dec. 26, 1928, 18½ cents.

Normal Trend Continues in Eastern District

Year-end transactions in electrical equipment continue on a satisfactory basis in the Eastern district. A number of sizable contracts have matured and inquiries are brisk. Central stations are expected to show some heavy commitments in January, 1929. A metropolitan power company has ordered a quantity of network protectors to cost $125,000. A municipality in Arkansas has placed a contract with an Eastern manufacturer for equipment for a power station to cost $35,000. A power station project on the Delaware River, on the New Jersey side, is progressing rapidly and a 42,000-kw. installation will be made during the coming year. The state of Pennsylvania is planning a steam-operated generating plant to cost $1,000,000.

Motors and affiliated equipment are again taking the lead in industrial demand and some heavy business is anticipated. A New York paper company has purchased four synchronous motors with accessories for a mill in Canada, costing $35,000. A chemical company in New Jersey has contracted for miscellaneous switchgear apparatus to cost $25,000. An automobile body company located in Michigan will soon make purchases for a $3,000,000 plant in Tennessee. Switching equipment is securing a fair volume of business, while switchboard panels and instruments show greater promise for the weeks ahead than in immediate transactions. A maker of outdoor electric displays has placed an order for a quantity of small size transformers with a New York manufacturer, to cost $50,000. A manufacturer of control apparatus reports the present situation as entirely satisfactory and has taken a large order for such equipment, including magnetic brakes, etc., for a Canadian project.

A manufacturer of electric elevators says that business is good, with inquiries holding at a high level. An order has been taken for an installation in a new department store in Brooklyn, including motors and auxiliary equipment, to cost $80,000. Another commitment has been received for an office building in New York, costing $30,000. Construction projects are as follows:

The American Cyanamid Company, New York, plans expansions in plants at Niagara Falls, N. Y., Warners, N. Y., and Plant City, Fla., to cost $2,500,000. The

Dry Ice Company, New York, plans a plant at Niagara Falls, to cost $100,000. The Anheuser-Busch Ice & Cold Storage Company, New York, will build a plant at Richmond Hill, L. I., to cost $150,000. The Percy Kent Manufacturing Company, Brooklyn, plans a burlap bag manufacturing plant at Norfolk, Va., to cost $200,000. The International Milling Company, Buffalo, N. Y., plans an addition to its grain elevator to cost $500,000. The Delaware, Lackawanna & Western Railroad Company is asking bids for certain work in connection with the proposed electrification of suburban lines in New Jersey, to cost $10,000,000. The Board of Education, Buffalo, N. Y., will receive bids until Jan. 10 for a vocational school, to cost $750,000. The Signal Supply Officer, Signal Corps, Brooklyn, N. Y., will receive bids until Jan. 10 for electric resistances, control boxes, electric cords, etc. (Circular 71). The K. & L. Ice Corporation, New York, will build an ice-manufacturing plant at Newark, N. J., to cost $250,000. The Perryman Electric Company, North Bergen, N. J., will build a radio equipment factory addition to cost $85,000. The Spicer Manufacturing Company, South Plainfield, N. J., plans an addition to its plant at Toledo, Ohio, to cost $80,000. Perth Amboy, N. J., contemplates an addition to its municipal electric lighting plant. The United States Gypsum Company, Chicago, plans units for its proposed plant at Philadelphia, to cost $400,000. The Sun Oil Company, Philadelphia, plans additions to its refining plant at Marcus Hook, Pa., to cost $250,000. The Pennsylvania Flexible Metallic Tubing Company, Philadelphia, plans an addition to cost $65,000. The Department of property and Supplies, Harrisburg, Pa., plans a power plant to cost $1,000,000. Pittsburgh, Pa., contemplates an improved lighting system. The Kerotest Manufacturing Company, Pittsburgh, plans an addition to its valve-manufacturing plant to cost $100,000.

Power Company Supplies Feature in New England

Large central-station equipment orders feature New England buying. During the past week orders for central-station equipment amounting to over $600,000 were placed. An allotment consisting of two 35,000-kva. transformers, two 12,000-kva. transformers and six 132-kv. circuit breakers, altogether amounting to $300,000, was reported. Another large order consisting of switch and control equipment for a new substation amounting to about $200,000 also was reported and special control amounting to $100,000 was allotted to a Massachusetts manufacturer. Small motor sales have been steady and during the present month have maintained a high level. According to one manufacturer this district will show about a 14 per cent gain, and another notes a similar trend. A number of large equipment orders remained to be placed, including several large units for power expansion in plants. Orders for scheduled materials, electrical specialties and appliances show a level trend. Construction projects are as follows:

The Edison Electric Illuminating Company, Brockton, Mass., plans a substation on Riverview Street, to cost $40,000. The Cohn & Rosenberger Company, Providence, R. I., will build a jewelry-manufacturing plant to cost $150,000. The Narragansett Electric Company, Providence, R. I., plans an addition to its generating plant to cost $500,000, and a new power substation to cost $550,000. Richards & Company, Inc., Stamford, Conn., will build an addition to its rubberized cloth and chemical manufacturing plant to cost $100,000.

Southeast Reports Orders Numerous But Small

Business is fairly well sustained in the Southeast for the period of the year, but such orders as are coming through are individually small. One large power company's creosoted pine pole orders aggregated $11,200 and a central-station order amounting to $20,000 for disconnect switches is in immediate prospect and will probably be placed this week. Another power company order in prospect is for equipment going into a 2,000-kva. substation for industrial purposes. A rayon plant being constructed in Georgia was responsible for a $35,000 order for switchboard and wiring materials placed last week. A cotton mill in Georgia has let a contract covering an addition to its twisting mill and wiring materials to the extent of $20,000 will be required.

Contracts have been let on a new knitting and spinning mill in Tennessee and a new spinning mill in North Carolina, requiring in electrical materials $25,000 and $12,000, respectively. Jobs expected to be let are an addition to a cotton mill in South Carolina involving $40,000 in electrical materials and an electrification and rearrangement of plant layout of an Alabama mill calling for $20,000 in electrical materials and equipment. One of the smaller industrial towns in North Georgia ordered white-way equipment totaling $6,000. The city of Atlanta will order during the coming week a panelboard and wiring materials amounting to $3,000 for a new school building. Construction projects are as follows:

The Richmond Car Works, Richmond, Va., plans extensions in its railroad car shops to cost $450,000. The Virginia Electric & Power Company, Richmond, Va., will build an addition to the 66,000-volt transmission line in the northeastern part of North Carolina, including a new line from Quantico to Occoquan, Va., to cost $1,000,000. The Eastern Silica & Chemical Company, Winchester, Va., plans a mill and pulverizing plant, to cost $85,000. The Alabama Power Company, Birmingham, Ala., plans a transmission line at Plantersville and Maplesville, Ala., and vicinity.

Holiday Business Large in St. Louis Area

After an unusually good pre-holiday business in all lines of electrical trade in the St. Louis district there has been a noticeable slacking up during the last week. A contract amounting to $210,000 was let by the city of St. Louis for street lights in the western central district. This is one of the smaller districts into which the city has been divided for the eight-million-dollar lighting program. Sales reported are a portable cable testing set costing $4,000, a centrifugal air compressor costing $3,000 and substation equipment with two 100-hp. motors amounting to $11,500. Inquiries are being received from lead mining companies in the southeast part of Missouri, which indicate increasing activity in that territory early in the new year. Construction projects are as follows:

The Midwest Boat Manufacturing Company, Grafton, Ill., plans a plant at St. Louis, to cost $80,000. Kirksville, Mo., plans an early call for bids for a municipal light and power plant to cost $250,000. Heckenlively & Mark, Springfield, Mo., engineers, plan a hydro-electric power plant, near Roaring River, Mo. The General Metals Refining Company, St. Louis, plans a plant to cost $100,000. The I. T. Cook Company, St. Louis, plans a factory for the manufacture of automobile truck bodies to cost $100,000. The Red Wing Commercial Aircraft Company, St. Joseph, Mo., contemplates an aircraft manufacturing plant to cost $85,000. The St. Louis Public Service Company, St. Louis, plans an equipment storage and distributing plant to cost $45,000. The Pauline Hosiery Mills, Inc., Little Rock, Ark., plan additions to cost $75,000. The Oklahoma Gas & Electric Company, Oklahoma City, Okla., plans an ornamental lighting system at Enid, Okla. The Banfield Brothers Packing Company, Tulsa, Okla., plans an addition to its abbatoir and meat packing plant to cost $225,000. Big Springs, Tex., plans extensions in the ornamental lighting system in the business district. Dallas, Tex., contemplates a municipal electric plant for power service for the city waterworks to cost $400,000. The El-Food Corporation, Real Arts Advertising Company, and Kennedy Machine & Brass Company, Dallas, Tex., affiliated organizations, plan a group of factories to cost $200,000. The Southwestern Portland Cement Company, El Paso, Tex., plans a power plant to cost $100,000, and will make extensions in mill to cost $40,000. The Texas Bread Company, Houston, Tex., will build an addition to its baking plant to cost $125,000.

Industrial Orders Large in Middle West

General business in the Middle West section continues on a satisfactory basis. The coming year is viewed with a pleasant anticipation with every promise of continuing prosperity. While most industries are shutting down the final week in the year for inventory, the retail merchants are completing a very favorable holiday season. Reports from the steel and automotive industries are satisfactory and car loadings are comparatively large. The various utility companies are entering the inventory period and preparing for extensive activity after the first of the year. Among the interesting orders placed were the following: Seventeen return bend economizers complete with appurtenances, installation of a piping system for a substation valued at $250,000, structural and plumbing work valued at $125,000, oil circuit breaker equipment valued at $50,000, and Mazda lamps valued at $150,000. Jobbers' sales are normal and the extensive holiday activity has tended to reduce stocks to a minimum and is bringing the season to a satisfactory close. Construction projects are as follows:

The Consumers Power Company, Jackson, Mich., plans an addition to its power

plant at Kalamazoo, Mich., to cost $150,000 and will build a power substation at Grand Rapids, Mich., to cost $50,000, and an equipment storage and distributing plant at the last noted place, to cost $45,000. The Baker Stove Company, Belleville, Ill., plans a plant unit to cost $50,000. The Lanzit Corrugated Box Company, Chicago, will make extensions to cost $175,000. The Pellar Pie Company, Chicago, will build a baking plant to cost $500,000. The Pines Winter Front Company, Chicago, plans a plant for the manufacture of radiator shutters for automobiles to cost $1,000,000. The Western Packing & Provision Company, Chicago, plans a factory to cost $200,000. The Stockade Corporation, Joliet, Ill., will build a factory to cost $100,000. Riverside, Cicero and Brookfield, Ill., plan ornamental lighting systems. The Continental Carbon Company, Cleveland, plans an addition to cost $65,000. The John Scherz Sons Company, Cleveland, will build an awning and tent manufacturing plant to cost $100,000. The Columbus Airport Commission, Columbus, Ohio, plans a floodlighting system and beacon lamps at its proposed municipal airport, to cost $800,000. The Chase Brass & Copper Company, Bridgeport, Conn., will build a power plant in connection with the manufacturing works at Euclid, Ohio, to cost $1,000,000. The Ohio Power Company, Newark, Ohio, plans an addition to the generating plant at Philo, Ohio, and extensions in transmission lines to cost $19,000,000. The Black Hills Marble Quarries Corporation, Rapid City, S. D., plans a plant to cost $100,000. Reid, Murdock & Company, Chicago, plans a food canning plant at Rochester, Minn., to cost $100,000. St. Paul, and Breckenridge, Minn., plan ornamental lighting systems. The Municipal Utilities Company, Des Moines, Iowa, contemplates a power plant at Clarion, Iowa, to cost $100,000. The Des Moines Steel Tank Company, Des Moines, Iowa, plans an addition to its plant to cost $65,000.

Central Stations Boost Pacific Coast Business

Power company business provided most of the orders on the Pacific Coast, including one carload of fiber conduit, one carload of rigid iron conduit, one carload of 7-in. 35-ft. treated poles for Sacramento, one carload of 10-in. 65-ft. treated poles for Fresno, $3,000 worth of assorted No. 4/0 size 600-volt paper-insulated cable and $3,500 worth of 4,500 volt lead-insulated cable. The outstanding order to be placed covered three carloads of insulators, two carloads each of wire, crossarms and hardware for the Truckee River Power Company lines connecting Truckee and Reno with lumber developments in Portola and Loyalton areas, totaling about 70 miles of line. Industrial business includes a group of 60-hp. synchronous motors and accessories which are valued at $10,000, a 150-hp. motor valued at $3,000, two carloads of 25- and 35-ft. poles for an oil company at Ventura and 700 treated poles, 12-in. butts, length 35 to 40 ft., for a cement company. Street-lighting business includes orders for 32 units for Marysville and 33 for Antioch, an Oakland award for $39,850 covering 125 standards, and prospective jobs covering 51 units for Redwood City, and 50 for Sacramento, Calif. The West Coast Theater Company is to build 50 theaters along the Pacific Coast in 1929, at an estimated cost of $15,000,000.

The only large sale reported in the Puget Sound district was $50,000 worth of apparatus for a pulp and paper manufacturing plant at Hoquiam, Washington, involving one 400-kw. motor generator set, four 200-hp. motors and a number of smaller motors. Smaller sales included a 100, 60 and 30-hp. and several 5-hp. motors for a lumber mill in Thurston County; two 12-in. pumps and two 50-hp. motors for a drainage district in Skagit County and one 10-in. pump and a 150-hp. motor for a water system in Whatcom County. During November the Puget Sound Power & Light Company sold in excess of 900 electric ranges in the Puget Sound district of which 550 of these were sold in the city of Seattle, while the city of Seattle's municipal lighting department sold approximately 400 in Seattle alone. The Seattle purchasing department has opened bids for 30,000 ft. of 600-volt copper wire. Construction projects are as follows:

The California Porcelain Company, Richmond, Calif., plans a plant to cost $50,000. The Bureau of Supplies and Accounts, Navy Department, Washington, will receive bids until Jan. 8 for four turbines and spare parts for the Mare Island navy yard, San Francisco, Calif., and the Puget Sound yard, Seattle, Wash. (Schedule 192). Gildred Brothers, San Diego, Calif., will build an automobile service and repair garage to cost $150,000. Monroe, Utah, and Salida, Colo., plan ornamental lighting systems. Casa Grande, Ariz., plans an improved street-lighting system to cost $50,000. The Silver City Power & Light Company, Silver City, N. M., plans a transmission line to Lordsburg, N. M., and vicinity, to cost $50,000.

Activities of the Trade

American Brown Boveri Reports Increased Sales

Considerable progress in the reorganization of its capital structure has been made by the American Brown Boveri Electric Corporation during the year, although there has been a falling off in earnings. Orders booked during the year show a substantial increase over 1927, although in the first three months the orders were running about 9 per cent under the corresponding period of the previous year. The business booked by the Packard Electric Company, which was recently taken over, has been running well in excess of that of any previous year. The Maloney Electric Company was also taken over during the year.

Allis-Chalmers Finds Tractor Business Profitable

Sales of the Allis-Chalmers Manufacturing Company this year will establish a new record according to present indications; the previous high, $33,315,252, was reached in 1927. During the first nine months of 1928 sales amounted to $26,732,537, which is an increase of 6.7 per cent over the same period of 1927. Early this year the company acquired the Monarch Tractor Company of Springfield, Ill., and has recently completed a contract with the United Tractor & Equipment Company by which the latter will market a light tractor. It is stated that this year's tractor sales alone have totaled well over $6,000,000, or around 20 per cent of the company's total production. All this has made possible an increase in the earnings per share, which for the first nine months of the year were $8.55 on the 260,000 shares of $100 common, against $7.26 in 1927. The company's business record for the past six years is shown in the accompanying table.

Year Ended Dec. 31	Sales Billed	Net Income
†1928	$26,732,537	$2,223,631
1927	33,352,252	3,182,472
1926	30,682,543	3,596,891
1925	28,921,357	3,417,368
1924	27,855,523	3,221,100
1923	25,612,709	2,703,636

†To Sept. 30.

International Combustion Gets New York Contract

A contract for three boilers, claimed to be the largest yet built, for the New York Edison and associated companies has just been closed with the International Combustion Engineering Company. They are to be installed in the East River generating station of the New York Edison Company and will supply steam to drive what is said to be the largest single-shaft, single-unit electric generating machine in the world, a 160,000-kw. (215,000-hp.) turbo-generator which is now being constructed by the General Electric Company.

The over-all height of the boilers, which are of the double Ladd type with fin tube water walls, will be 95 ft., with furnaces 23 ft. wide and extending back 65 ft. Each will supply a maximum of 800,000 lb. of steam per hour at a temperature of 700 deg. F. at 425 lb. per square inch pressure. With a heating surface of 60,000 sq.ft. each, the compactness of this battery of boilers will make them not only the greatest producers of steam in the world but also the most economical for the space occupied and the coal consumed. Each of

the boilers will require 80,000 lb. of coal an hour, or nearly 1,000 tons a day, if operated continuously at that rate.

Delivery of the boilers is expected to start in about four months and the unit will be placed in operation about Sept. 1, 1929.

The total capacity of the circulating pumps in the East River generating station of which these units will form an integral part will be 1,400,000 gal. of water per minute or 1,750,000,000 gal. in twenty-four hours.

THE INTERNATIONAL COMBUSTION ENGINEERING CORPORATION, 200 Madison Avenue, New York City, announces the appointment of Carl F. Weigel as vice-president and general manager of the subsidiary company, the Hedges-Walsh-Weidner Company, Chattanooga, Tenn. From the date of the combination of the Walsh & Weidner Boiler Company and the Casey-Hedges Company up to the present Mr. Weigel has served as chief engineer of the combined organization.

THE INDEPENDENT ELECTRIC WORKS of Chicago announces that C. F. Holmes, an inventor associated with it, has developed a new three-rate service station charger. Through his invention of a special new switch the charger can be made to charge batteries at three different rates. It is stated that the new charger saves 40 to 60 per cent in electric current and yet handles 50 to 70 per cent more batteries.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has received an order from the Miami Copper Company for new switching equipment. The order calls for thirteen electrically operated type B-32 oil circuit breakers, together with supporting frame, disconnecting switches, copper bus and connections, busbar supports, instrument transformers and bolted steel structures.

THE LINCOLN ELECTRIC COMPANY, Cleveland, manufacturer of "Linc-Weld" motors and "Stable-Arc" welders, has produced an educational motion picture portraying the advantages of arc welding and the widespread possibilities of its application. The new film is entitled "Modern Manufacturing with a 'Stable-Arc' Welder."

THE GAMEWELL COMPANY, Newton Upper Falls, Mass., manufacturer of electric signal systems, announces the purchase of the Holtzer-Cabot Electric Company of Boston.

THE WAGNER ELECTRIC CORPORATION, St. Louis, announces that R. L. Matthews has joined the sales force of its Chicago office. Mr. Matthews has been formerly connected with such organizations as the Michigan Bell Telephone Company, the Armstrong Cork & Insulation Company and the National Electric Products Corporation.

THE SYNTHANE CORPORATION, Philadelphia, recently organized, is completing the building of its plant at Oaks, near Philadelphia, and expects to commence the production of laminated bakelite products in the spring. R. R. Titus, formerly vice-president and general manager of the Diamond State Fibre Company and the Celoron Company of Bridgeport, Pa., is president of the corporation, J. B. Rittenhouse is vice-president and George J. Lincoln is secretary and treasurer.

THE GENERAL ELECTRIC SUPPLY CORPORATION, New York, wholesaler, announces that its main New York warehouse, offices and showrooms are now located in larger quarters at 585 Hudson Street.

THE R. D. NUTTALL COMPANY, McCandless Avenue and Harrison Street, Pittsburgh, manufacturer of Westinghouse-Nuttall gears, has appointed H. A. Houston of Wilkinsburg, Pa., as works manager of its company. Since 1920 Mr. Houston has been manager of the mechanical parts and of the railway equipment engineering department of the Westinghouse Electric & Manufacturing Company, of which the Nuttall company is a subsidiary.

THE BOSSERT CORPORATION, Utica, N. Y., has leased the plant of the Sherman Sales Company for the expansion of its business. The new plant will give 27,000 additional square feet of floor space which it is understood will be used in the manufacture of the newest and most successful of the Bossert products, the electrical household appliances.

THE ANACONDA COPPER MINING COMPANY reports what is claimed to be the first order for an all-copper hollow conductor cable ever received by a United States manufacturer for European use. The order came from the Societa Meridionale de Electricitta, Naples, Italy. The cable, which will transmit energy 118 miles from Pescara to Naples, in three-phase operation, requires more than 1,850,000 lb. of material. This type of construction has been developed to insure efficiency in transmitting large voltages over long distances.

THE BENJAMIN ELECTRIC MANUFACTURING COMPANY, 128 South Sangamon Street, Chicago, announces that L. W. Kester, formerly assistant to the vice-president in charge of sales, has been appointed merchandising manager of its electrical division. Mr. Kester will be chairman of the merchandising committee of the company and R. W. Staud, advertising and sales promotion manager, will be secretary of the committee.

THE METROPOLITAN-VICKERS ELECTRICAL COMPANY, Manchester, has passed a resolution agreeing to change the name of the company to Associated Electrical Industries, Ltd. It was announced that at a recent board meeting a number of the directors resigned and that in their places were elected several new directors who would include representatives of the various interests. The directors who resigned will become directors of Metro-Vick Electrical Products, Ltd., so that they will be indirectly connected, as previously, with the activities of the trading concern.

THE SOUTHERN NEW YORK ELECTRICAL SUPPLY CORPORATION, Binghamton, N. Y., has recently appointed as new directors G. W. Brooks, M. H. Georgia and E. C. Wehle. The company has increased its capital stock from $50,000 to $150,000.

New Equipment Available

Fiber Hand Trouble Lamp

A non-conductive shockproof, fiber portable lamp, with adjustable hook, that is equally well suited for use in

homes, factories, garages and on telephone and power switchboards, has been produced by the Benjamin Electric Manufacturing Company of Chicago. Although weighing only 8 oz. it is sturdily constructed and will stand the weight of a 180-lb. man without injury to the lamp. A special floating socket and four flexible springs protect the lamp from mechanical jars and breakage and absorb shocks that would otherwise be transmitted to the lamp filament. The handle is of varnished hard maple, to which is attached a notched fiber guard that prevents the light from rolling when placed on a flat surface. An additional feature is a fiber half shade to direct the light rays on the work and out of the user's eyes. This portable will take lamps from 25 to 60 watts.

Bates Computing Index

The Bates Index, manufactured by the Bates Manufacturing Company, Orange, N. J., has been adapted by the Hydro-Eectric Power Commission of Ontario, Canada, as an instantaneous reference log for computing domestic hydro bills. By the same method illustrated herewith, both water and gas bills can also be computed with absolute accuracy and without loss of time. The commission writes: "By working

out a chart showing the energy charge, gross and net value for all reasonable consumptions, we found it possible to devise a form of bill which, with the aid of this chart, could be made out in a fraction of the time required to figure each one, especially where the fractions were troublesome."

Threadless Thin Wall Conduit

A new type of conduit has been devised by the electrical division of Steel & Tubes, Inc., Cleveland, Ohio, a subsidiary of the Republic Iron & Steel Company. The new product is classified as "Steeltubes" electrical metallic tubing and is a thin-wall rigid conduit, having all of the characteristics of the so-called heavy standard conduit, but with a lighter wall. Its construction of cold-rolled open-hearth steel insures a basic quality which is designed to resist corrosion and to provide a tube sufficiently ductile to be readily bent to any desired shape by use of a special bending hickey supplied by the manufacturer.

The wall of the conduit is approximately one-third the thickness of the standard conduit. It is used without threading, connections being made by means of a union compression type coupling. Part of the coupling may be used as an adapter to connect the conduit to any standard fitting.

Electrical Patents

Announced by U. S. Patent Office

(Issued Dec. 11, 1928)

Reissue 17,156. HOLLOW CONDUCTOR; W. H. Bassett, Cheshire, Conn. App. filed May 17, 1927.

Reissue 17,161. TURBINE-GOVERNING SYSTEM; W. Innes, Monkseaton, England. App. filed Oct. 10, 1928.

1,694,398. SWITCHBOARD MOUNTING OF CIRCUIT-BREAKER UNITS; W. M. Scott, Treddyfrin Township, Chester Co., Pa. App. filed Aug. 2, 1923.

1,694,400. SOCKET AND SWITCH PLUG; E. Sjolin, Chicago, Ill. App. filed Jan. 11, 1922.

1,694,415. INSULATOR; C. S. Gordon, New York, N. Y. App. filed July 1, 1925.

1,694,434. STANDARD LAMP OF CANDELBRA TYPE; J. H. Baetz, Kitchener, Ont., Can. App. filed Feb. 17, 1928.

1,694,448. SWITCH-CONTROLLING DEVICE; G. H. Middlemiss, Birmingham, Ala. App. filed June 21, 1923.

1,694,460. ALTERNATING-CURRENT MOTOR; H. Weichsel, St. Louis, Mo. App. filed July 11, 1925.

1,694,479. ELECTRIC SWITCH; J. L. Milton, Louisville, Ky. App. filed April 17, 1922.

1,694,512. ELECTRIC WELDING MACHINE; C. M. MacChesney and R. H. Norton, Chicago, Ill. App. filed Sept. 21, 1923.

1,694,530. CATALYTIC AGENT IN STORAGE BATTERY; D. W. Davis, Elmhurst, Ind. App. filed Aug. 5, 1927.

1,694,536. ELECTRIC FURNACE; C. B. Foley, Fort Wayne, Ind. App. filed March 13, 1920.

1,694,539. ELECTRICALLY-HEATED TILE STOVE; F. Graf, Baden, Switzerland. App. filed June 26, 1924.

1,694,555. WELDING MACHINE; H. M. Naugle and A. J. Townsend, Canton, Ohio. App. filed Sept. 18, 1926.

1,694,569. SWITCH; A. E. Walsh, Chicago, Ill. App. filed Sept. 14, 1925.

1,694,600. ELECTRIC RESISTANCE HEATING ELEMENT; H. S. Lee, Peabody, Mass. App. filed Feb. 12, 1927.

1,694,605. TESTING LAMP FOR HEAVY CURRENT INSTALLATIONS; J. F. Schleper, Amsterdam, Netherlands. App. filed Sept. 10, 1923.

1,694,611. AUXILIARY SWITCH; C. D. Ainsworth, Wollaston, Mass. App. filed Feb. 26, 1925.

1,694,612. CONTACT STRUCTURE FOR ELECTRIC SWITCHES; C. D. Ainsworth, Wollaston, Mass. App. filed May 29, 1925.

1,694,613. MOTOR-CONTROL SWITCH; C. D. Ainsworth, Wollaston, Mass. App. filed March 28, 1921.

1,694,618. ELECTRICAL APPARATUS AND SWITCH; G. A. Burnham, Saugus, Mass. App. filed April 29, 1924.

1,694,637. SPEED REGULATOR; J. Bethenod, Paris, France. App. filed June 2, 1923.

1,694,649. APPLICATOR-SECURING MEANS; E. R. Goldfield and C. Horsley, Cleveland, Ohio. App. filed Feb. 14, 1927.

1,694,653. ELECTROLYTE AND ELECTROLYTIC APPARATUS; R. E. Hall, Evanston, Ill. App. filed Oct. 14, 1922.

1,694,692. MAGNETIC CIRCUIT-CONTROL APPARATUS; S. Seaberg and H. W. Anderson, Moline, Ill. App. filed Oct. 28, 1924.

1,694,700. CENTRIFUGAL OPERATING MECHANISM; W. J. Branson, Springfield, Ohio. App. filed Sept. 28, 1926.

1,694,707. OUTLET BOX; C. A. Johnson, Chicago, Ill. App. filed June 13, 1924.

1,694,709. BRUSH HOLDER FOR ELECTRIC GENERATORS OR MOTORS; R. G. Lafite, Kansas City, Mo. App. filed Dec. 15, 1926.

1,694,712. ELEVATOR SYSTEM; D. L. Lindquist, Hartsdale, N. Y. App. filed May 21, 1925.

1,694,715. CONTACT DEVICE FOR ELECTRICALLY-ENERGIZED IMPLEMENTS; M. W. McArdle, Chicago, Ill. App. filed March 18, 1927.

1,694,725. HEATING APPARATUS; W. T. Tabb, Mahwah, N. J. App. filed April 28, 1927.

1,694,762. ELECTRIC COOKER; P. Ackerman, Washington Co., Ore.; App. filed April 19, 1927.

1,694,791. INDUCTION ELECTRIC FURNACE; E. F. Northrup, Princeton, N. J. App. filed Feb. 14, 1925.

1,694,836. MERCURY VAPOR LAMP; W. Ulbrich, Jena, Germany. App. filed March 23, 1927.

1,694,837. RECTIFYING SYSTEM; F. L. Walker, Jr., Westwood, Calif. App. filed Feb. 23, 1926.

1,694,856. STORAGE BATTERY; J. G. Jackson, Chatham, Ont., Can. App. filed Jan. 2, 1925.

1,694,899. ELECTRIC SNAP SWITCH; W. Wurdack, Jr., St. Louis, Mo. App. filed June 3, 1925.

1,694,919. DRY-CELL ELEMENT AND METHOD OF MAKING THE SAME; L. G. Jenness, Leonia, N. J. App. filed Feb. 18, 1927.

1,694,927. CONDENSER STRUCTURE; H. E. Rice and R. C. DaCosta, Philadelphia, Pa. App. filed March 16, 1921.

1,694,928. THERMOSTAT; H. E. Rider, Lynbrook, N. Y. App. filed June 11, 1925.

1,694,962. METAL TUBING; E. R. Berry, Malden, Mass. App. filed June 6, 1923.

1,694,963. THEFTPROOF LAMP GLOBE; W. O. Bode and L. J. Haming, Louisville, Ky. App. filed June 24, 1924.

1,694,966. ELECTRIC SYSTEM; R. C. Clinker, Bilton, near Rugby, England. App. filed May 24, 1927.

1,694,977. CIRCUIT-CONTROLLING DEVICE; C. I. Hall, Fort Wayne, Ind. App. filed June 5, 1925.

1,694,979. HIGH-VOLTAGE PRIMARY CUT-OUT; E. G. Newton and E. J. Wade, Pittsfield, Mass. App. filed April 21, 1925.

1,694,981. ELECTRIC WAFFLE IRON; C. P. Randolph, Oak Park, Ill. App. filed Aug. 23, 1926.

1,694,984 and 1,694,985. SPEED CONTROL OF INDUCTION MOTORS; H. K. Schrage, Paris, France. Apps. filed April 8, 1925.

1,694,986. PROTECTIVE ARRANGEMENT; N. Sensui, Kanagawaken, Japan. App. filed Feb. 1, 1927.

1,694,990. VENTILATION OF DYNAMO-ELECTRIC MACHINES; E. G. Sohlberg, Schenectady, N. Y. App. filed March 22, 1927.

1,694,997. BASE FOR INCANDESCENT LAMPS OR SIMILAR ARTICLES; I. H. Van Horn, East Cleveland, Ohio. App. filed Sept. 20, 1926.

1,695,003. CONTROL OF ELECTRIC SWITCHES; A. E. Anderson, Scotia, N. Y. App. filed March 19, 1927.

1,695,004. AUTOMATIC CONTROL SYSTEM; H. Bany, Scotia, N. Y. App. filed July 22, 1927.

1,695,007. HANGER FOR ELECTRIC WIRES; C. A. Cawood, Big Stone Gap, Va. App. filed April 18, 1927.

1,695,032. IMPEDANCE-MEASURING BRIDGE; W. J. Shackelton, Scotch Plains, N. J. App. filed Oct. 16, 1925.

1,695,035. ELECTRIC REGULATOR; H. M. Stoller, Mountain Lakes, N. J. App. filed June 21, 1927.

1,695,038. MAGNETIC ALLOY; O. E. Buckley, Maplewood, N. J. App. filed March 6, 1925.

1,695,041. PRODUCTION OF MAGNETIC DUST CORES; G. W. Elmen, Leonia, N. J. App. filed Dec. 17, 1926.

1,695,047. ART OF ELECTRICAL MEASUREMENTS; J. W. Horten, Bloomfield, N. J. App. filed Nov. 4, 1924.

1,695,051. TRANSLATING CIRCUITS; W. A. Marrison, East Orange, N. J. App. filed May 6, 1925.

1,695,060. ELECTRICAL CONDENSER; W. H. Priess, Boston, Mass. App. filed Oct. 22, 1919.

1,695,089. THERMAL MINE; J. H. Deppeler, Weehawken, N. J. App. filed Nov. 2, 1926.

1,695,103. THERMOELECTRIC SWITCH; A. U. Hook, New Washington, Ohio. App. filed May 16, 1927.

1,695,122. ELECTRICAL TRANSFORMER; C. F. Phillips, Blackheath, London, England. App. filed Feb. 24, 1928.

1,695,155. STAPLE; G. A. Parker, Brockton, Mass. App. filed Feb. 2, 1927.

1,695,227. ELECTRIC WATER HEATER; E. E. Bolinger, Emmett, Idaho. App. filed March 21, 1928.

1,695,234. INSULATING SUPPORT FOR ELECTRIC RESISTANCE HEATING ELEMENT; L. J. Fuller, Bloomfield, N. J. App. filed April 8, 1927.

1,695,260. SWITCH MOUNTING; W. R. Walker, New Dorp, N. Y. App. filed Oct. 1, 1924.

1,695,261. THERMOSTATIC ELECTRIC SWITCH; W. J. Winninghoff, East Orange, N. J. App. filed Nov. 10, 1923.

New Trade Literature

ARC-WELDING ACCESSORIES AND STOKERS.—Leaflet L.20,398 issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., describes and illustrates its arc-welding accessories, which include protective welding helmets, hand shields, metal electrode holders, carbon electrode holders, welding cable and welding circuit reactors. The company also is distributing leaflet DMF-5130 describing its stokers for boilers and industrial furnaces.

GROUND RESISTANCE TESTER.—"Measurement of the Resistance to Earth of Ground Connections" is the title of technical bulletin No. 1185 issued by James G. Biddle, 1211 Arch Street, Philadelphia, covering the "Megger" ground resistance tester. The bulletin includes a description of the new direct-reading "Megger" ground resistance tester, comparison of various methods of test and data on the characteristics of earth.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number:

An agency is desired in Zurich, Switzerland (No. 35,090), for storage batteries for automobiles and another (No. 35,101), for household electric appliances, refrigerators, washing machines, etc.

An agency is desired in Johannesburg, South Africa (No. 35,100), for hard-drawn bare copper wire.

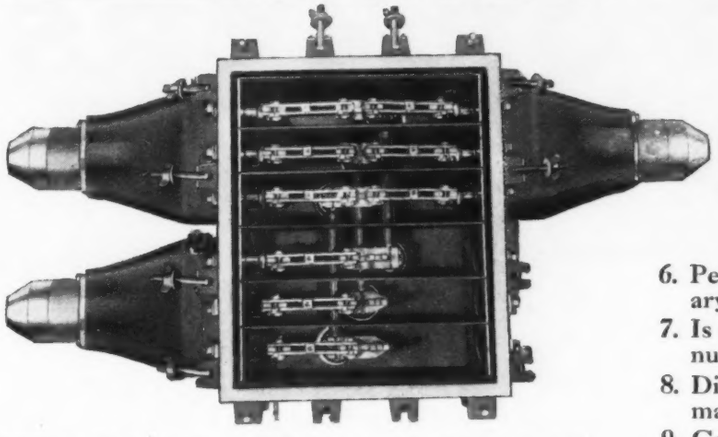
An agency is desired in Berlin, Germany (No. 35,104), for household electric refrigerators and another (No. 35,103), for household electric refrigerator units.

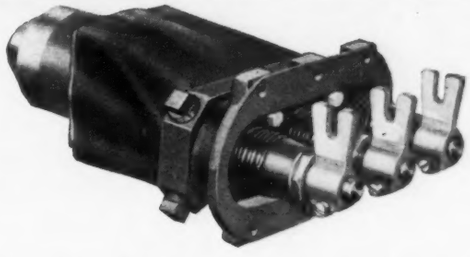
An agency is desired in Dresden, Germany (No. 35,102), for household electric refrigerator units.

An agency is desired in London, England (No. 35,105), for telephone instrument accessories and intercommunicating telephone systems.

TYPE 'H' BOXES

Particularly designed for switching a main to either of two circuits – also made for special conditions.





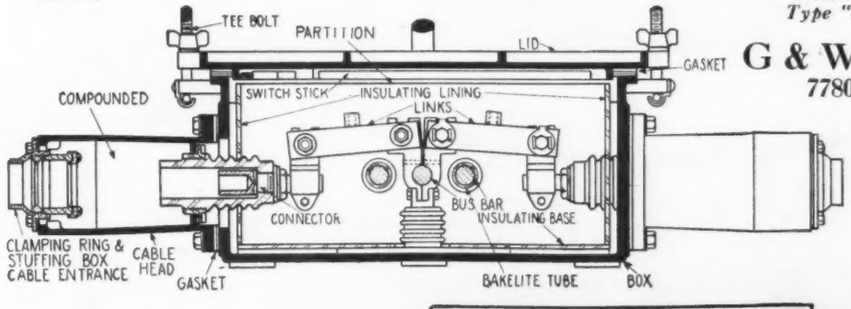
THE G & W Type "H" Box is the highest type of high tension interconnection box. It is designed as small and compact as possible, consistent with the clearance necessary.

G & W engineers have here again considered all types of underground conditions and requirements and designed Type "H" Boxes to adequately and economically fill a certain need in distribution systems.

The following are among the advantages found in the G & W Type "H" Boxes:

1. **Protects all cable ends against moisture.**
2. **Permits load to be thrown from one main to another.**
3. **Brings main and auxiliary feed up to center of load in a manhole located in business district.**
4. **Permits main and auxiliary feed to be cut in and out.**
5. **Provides auxiliary feeds to other distant locations.**
6. **Permits sectionalization of underground primary cables.**
7. **Is equipped with hinged cover bolts and wing nuts for speedy removal of cover.**
8. **Different types of cable heads for different manhole conditions.**
9. **Cable heads interchangeable.**
10. **Only one gasket between cable head and box.**
11. **Any style cable entrance optional.**
12. **Removable links with bolted contact.**
13. **Provides a moisture-proof enclosure for disconnects.**
14. **Provides a complete mechanical protection for disconnects and cables.**
15. **Tire valve provided to permit an air test after box has been opened and closed.**
16. **Made in from two to eight ways.**
17. **Made for one, two, three, and four conductor cables.**

The question of safety in operation is an outstanding Type "H" Box feature. The bus bars are all insulated so that only one phase is exposed in any one cell. It is economy to use Type "H" Boxes.



Ask a G & W representative about Type "H" Box advantages or write to us.

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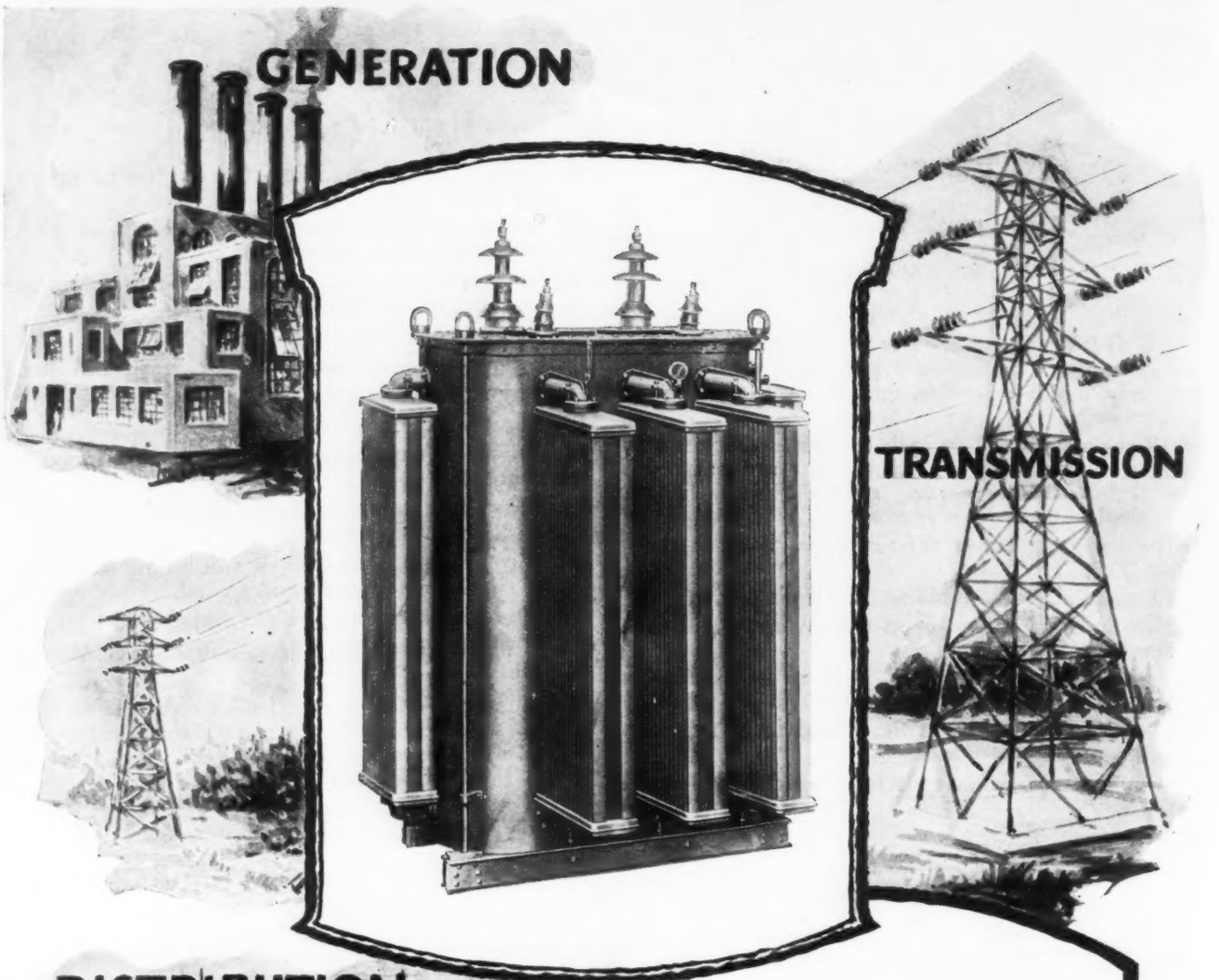
POTHEADS AND BOXES

MOLONEY
TRANSFORMERS



THE story of the reliability of Moloney Transformers is told and retold in years of satisfactory service on whatever type installation they may be used.

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General Offices and Factory:
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Offices in all principal Cities

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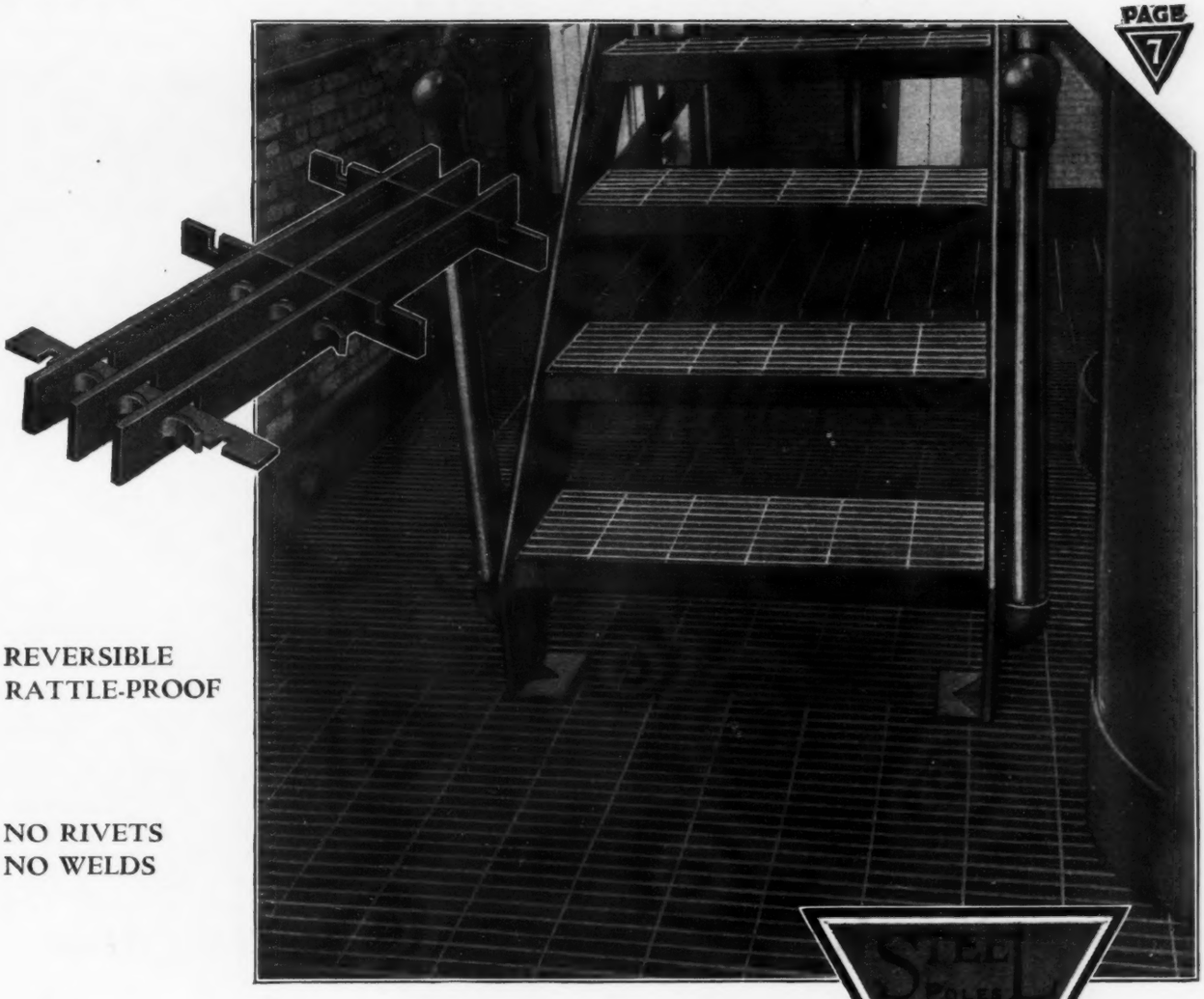

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because it is manufactured by automatic machinery in an efficiently laid out steel plant, we can maintain the *economy of its cost.*

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Specify these poles . . . *then cut your maintenance budgets for 40 years!*

PUT these strong, long-lasting Prettyman Preserved Poles of Southern Yellow Pine in your lines in 1929. Then forget them . . . forget replacement and maintenance costs until 1969. Creosoted under pressure, full length to the heartwood, they will last from 25 to 40 years—5 to 8 times the natural life of an untreated pole, which in 40 years would cost you something like 23 times its original price in replacements and labor.

Southern Yellow Pine is stronger, too. It has 44% higher static bending strength than the next strongest pole wood. Specify it and cut equipment costs by using fewer or smaller poles per given load. But be sure it is Prettyman Preserved for, however strong, untreated pine is highly susceptible to the attacks of termites (white ants) and decay-producing fungi. Write today for prices on air-seasoned Prettyman Preserved Poles, framed and treated to your own specifications.

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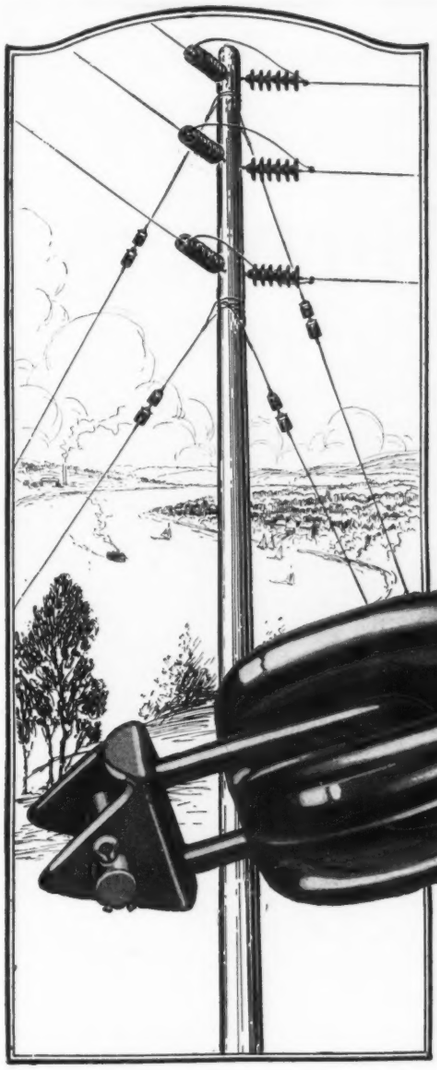
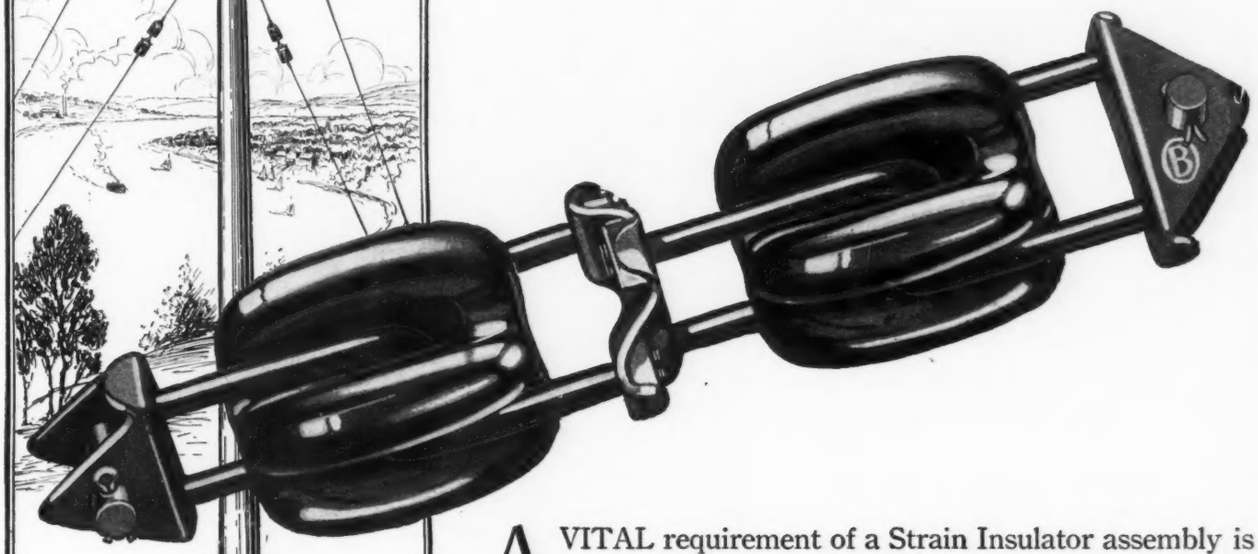


To Secure Greater Strength and Longer Life, Yet Preserve Electrical Efficiency



A VITAL requirement of a Strain Insulator assembly is strength. To attain high mechanical reliability and long life, without sacrificing electrical efficiency is the objective of O-B Strain Insulator Fittings—for use with Type XH, O-B Strain Insulators.

To secure the strength required in the porcelain, O-B Strain Insulators are ruggedly designed, with rounded corners and extra heavy fins to prevent breakage—yet with a long leakage path to maintain the electrical efficiency.

Combining these insulators with the proper O-B Strain Insulator Fittings governs the ultimate strengths obtainable—which range from 7,000 to 18,000 pounds.

O-B Strain Insulator fittings are carefully designed and constructed to secure high strength, yet to eliminate distortion and the concentrated pressure which causes cracking of the porcelain.

A wide variety of fittings are available, to provide for the various installation requirements. Without additional cost, complete assemblies to your specifications can be made at the factory, thus eliminating time and labor in the field.

O-B Strain Insulator Fittings—supplied for a variety of assemblies—are good quality steel, each piece being hot-dip galvanized. This galvanizing includes the threading of the bolts and nuts. The design is such that all nuts are ***locked on****—even when the insulator is not under load. Complete description and listing of Strain Fittings will be found on pages 85 to 95, O-B Cat. No. 20.*

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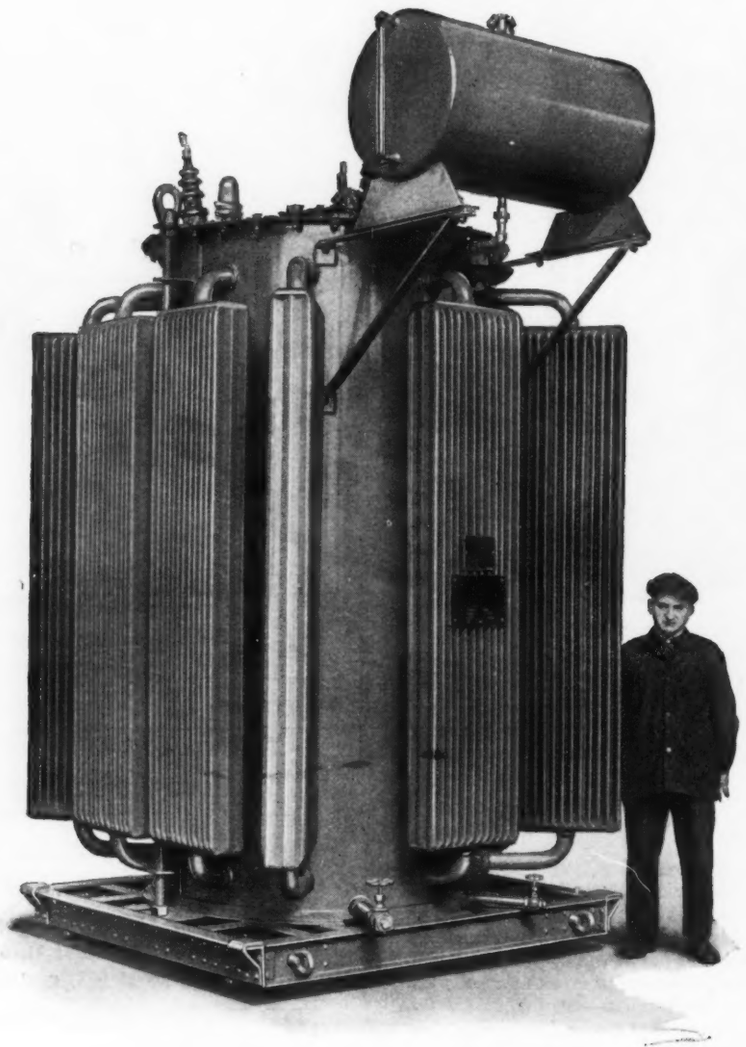

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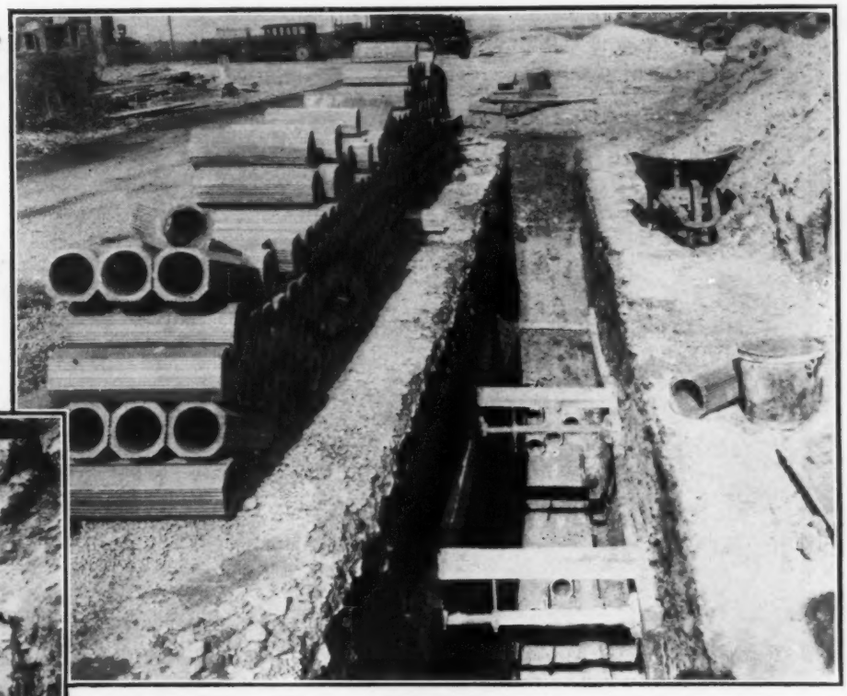
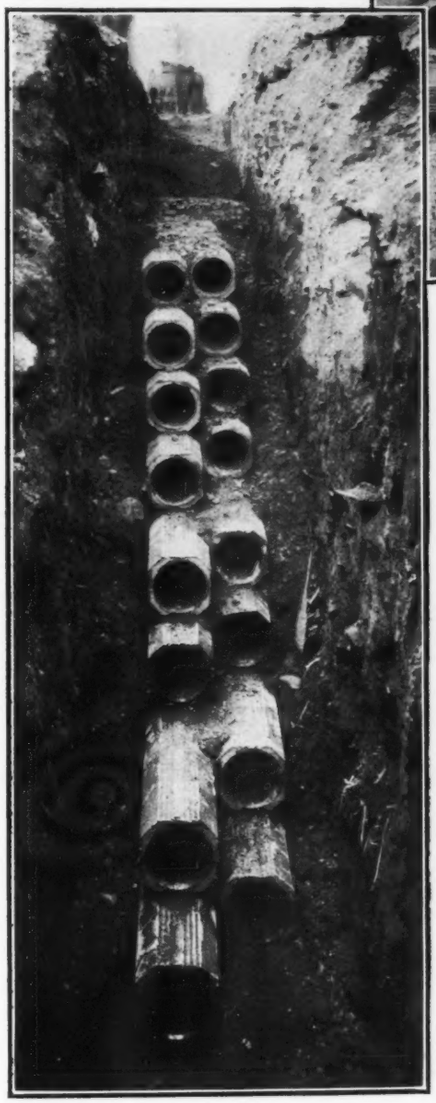
NATCO CLAY CONDUIT *for* POWER CABLES





Sixteen Duct Power Distribution line of 4¼ inch Round Single Duct Natco Clay Conduit, for the Philadelphia Electric Company, Philadelphia, Pa., October, 1928.

PAST PERFORMANCE THE REASON FOR 1928 INSTALLATIONS

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1. Protection Against Alkali Attack

NATCO's dense porcelain-like structure and impervious silicate glaze resist the penetration and attack of alkali; is *insoluble* and contains no elements that would harmfully affect the cable sheath.

2. Ready Dissipation of Heat

NATCO's dense structure, vitrified in a temperature of 2000 degrees, carries away cable heat—and at the same time is absolutely non-inflammable.

3. Easy Cable Pulling

The glass-hard, glass-smooth glaze, free from roughness and projections; the beveled ends of the units; and their freedom from distortion, all combine to make cable pulling easy, and eliminate danger of damage to the sheath.

4. Imperviousness to Moisture

Balanced vitrification (which produces maximum density with maximum strength) means low absorption and high resistance to moisture.

5. Accessibility

NATCO duct lines may be broken into for inspection and repair—and then, by means of split units, may be quickly and at a *low cost* restored to their original condition.

6. Permanence

Which has been adequately demonstrated in 35 years of responsible service.

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THE COMPLETE LINE of
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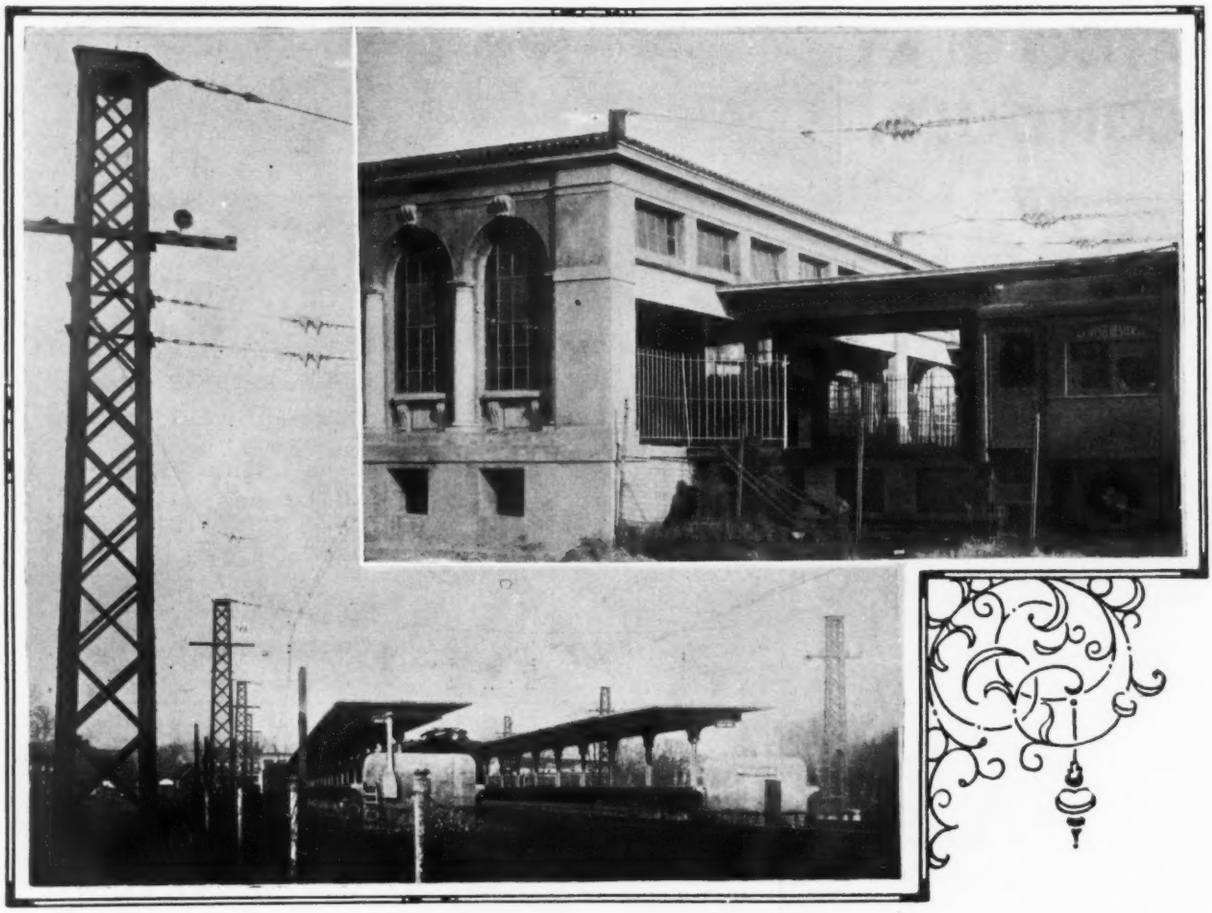

On several railway electrification jobs Jeffery-Dewitt thick porcelain insulators were installed with other makes. At least two of these railways have discovered the superiority of these thick porcelains for withstanding flashover without shattering—without calling for immediate replacements.

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Kenova, West Va., U. S. A.

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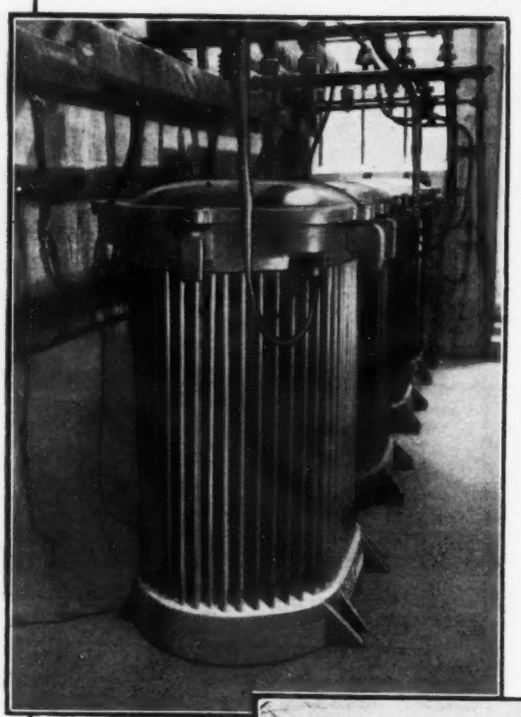

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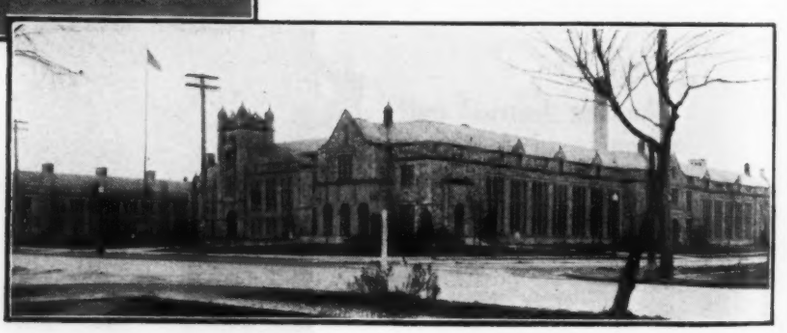

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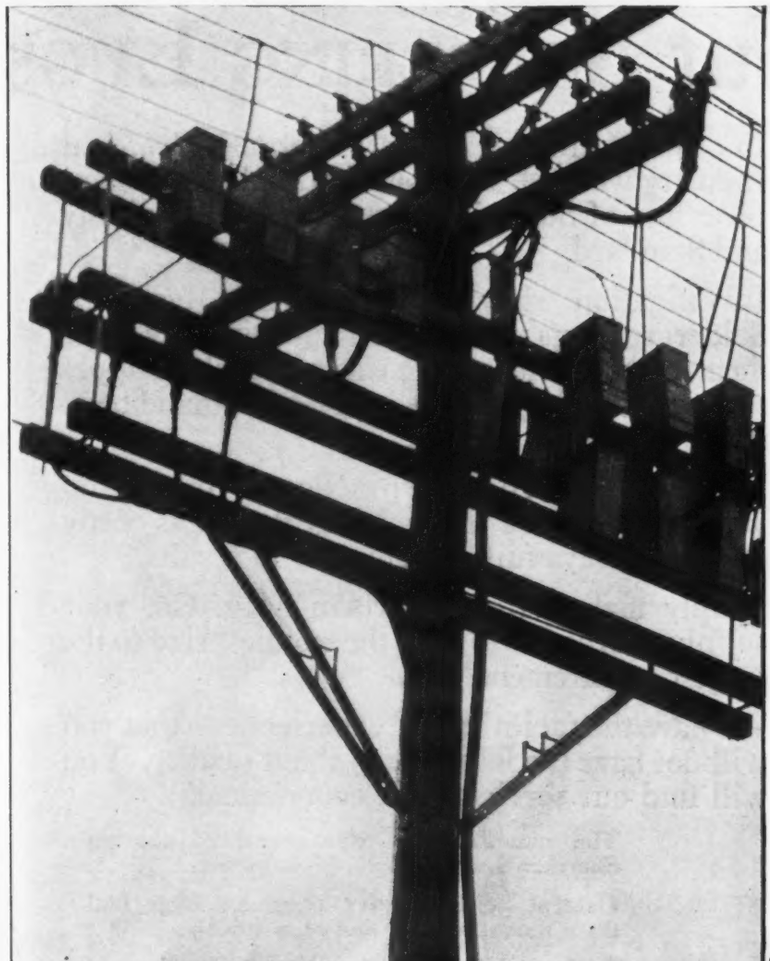

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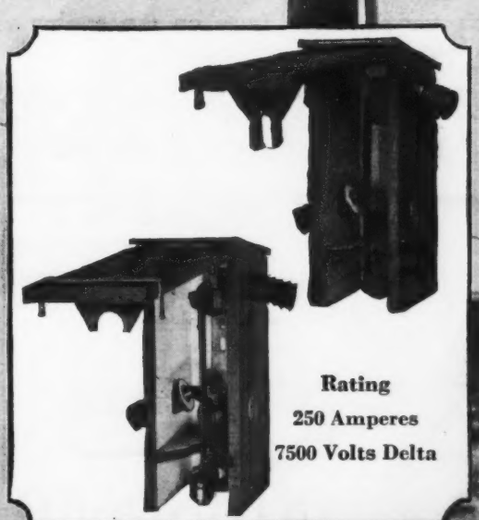

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The manufacturer who standardizes on Sherman Lugs protects his customers.

Central Stations using Sherman Lugs find them most practical and economical.

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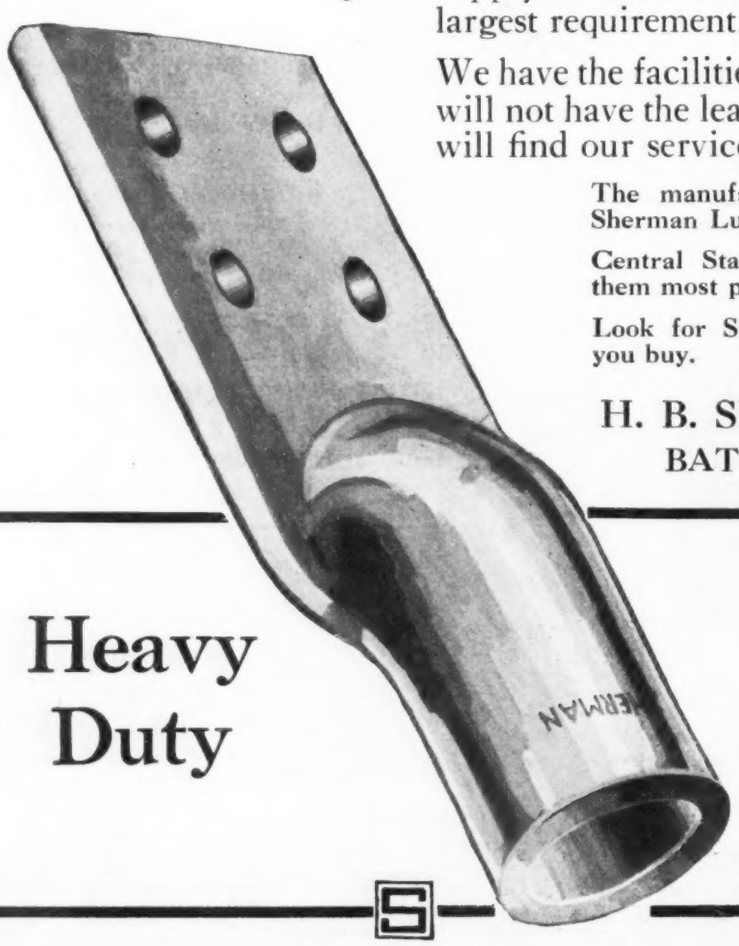
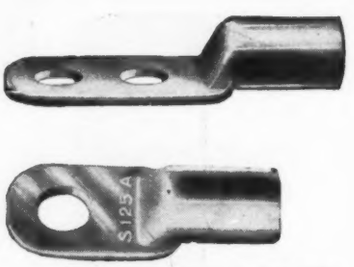


Heavy Duty



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A new leader in its class— The Switchboard Type FK-33

This 4500-volt, 200- or 400-ampere breaker for small stations or industrial installations is built double-, triple-, or four-pole; single- or double-throw.

It is
- Inexpensive
- Compact
- Easy to operate

It has
- Small over-all dimensions
- Bushings of non-breakable material
- An interrupting rating of approximately 20,000 kv-a.

The bushings consist of treated, wound, impregnated insulating cylinders permanently aligned to obtain definite position of the contacts, which require no adjustment.

The breaker can be supplied for back-of-panel, panel-frame, or remote mounting on pipe framework or flat surface.

G-E oil circuit breakers have behind them the services of a nation-wide organization of specialists and a permanent source of renewal parts. For complete descriptive information on the new Type FK-33 oil circuit breaker, ask the nearest sales office for a copy of publication GEA-1021.

470-10

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Overhead Street Lighting

Excellite Fixture

Excellite—A High Tension Fixture with Closed Top—Prevents scale from pipe bracket falling upon live parts.

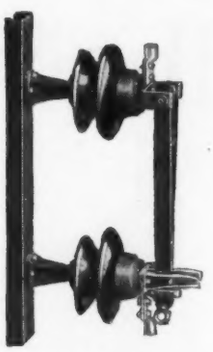
Will accommodate long or short cast aluminum or malleable iron reflector. Illustration shows Holophane Refractor and Aluminum Reflector. Standard Diamond Mesh Globe can also be added to this combination.

Many combinations are available, one of which will meet your needs.

Send for Overhead Street Lighting catalog

Outdoor Disconnecting Switches

For 4500 V. to 73000 V. service. Current carrying parts of Rolled Copper—Double trussed blade with tough phosphor bronze contact clips insuring ample uniformly distributed pressure at contact surfaces. Blade guides and all steel parts heavily galvanized. Furnished with or without locks. Interchangeability makes it possible to assemble any switch from stock. All switches are correctly assembled and tested before shipping.



Single Throw

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Ask our Salesman
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We make what you want made

High Tension Bus Bar Supports

Type H-H-L

Outdoor bus bar supports for 4500 to 73000 V. service. Standard supports can be equipped with bases for single or double pipe mounting or for flat horizontal or inclined mounting. All fittings and steel bolts, including malleable iron section of clamps, are hot galvanized—an important feature where permanence and low depreciation are essential. All supports are assembled and tested before shipping.

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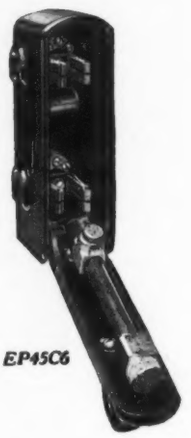
New 4500 Volt Expulsion Fuse

For service up to 60 amperes. Rugged wet process porcelain box with lips over lead entrances insuring high leakage and flash over values. Split bronze contact clips insure excellent contact. Non-warping removable bakelite door makes refusing easy. Heavy fuse terminals float on door—insuring perfect alignment. Leads fastened to fuse terminals by two screws.



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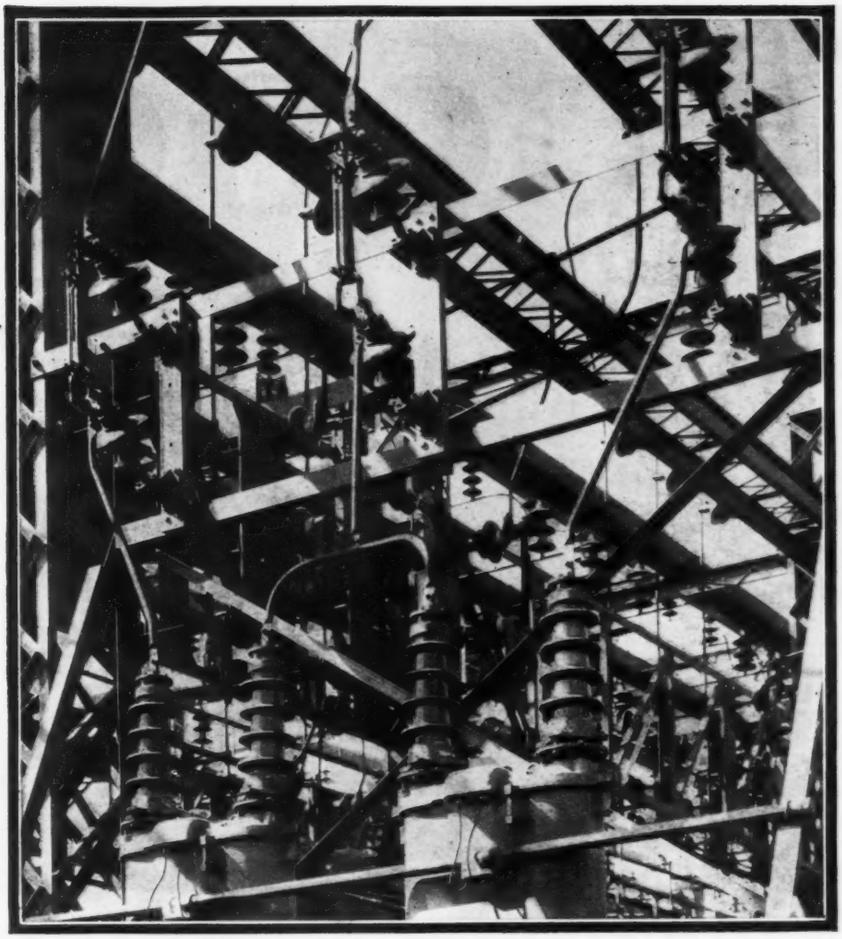
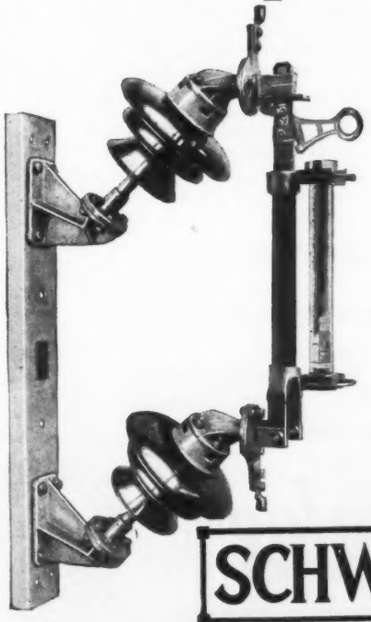
S&C Fuse and Disconnect in a Rugged well-made Combination for use



Where Space is Limited



The S&C Fuse you know and its reliability you know, but you may not be aware that there are available to go with it, mountings and combination equipment equally well made and reliable.

The Fused Disconnecting Switch in the installation pictured above is representative of S&C high quality switching equipment. There are 16 points in which it excels. Let us send complete information on this and other S&C Equipment, for either indoor or outdoor use.

Makers of the S&C *High Potential Fuse*

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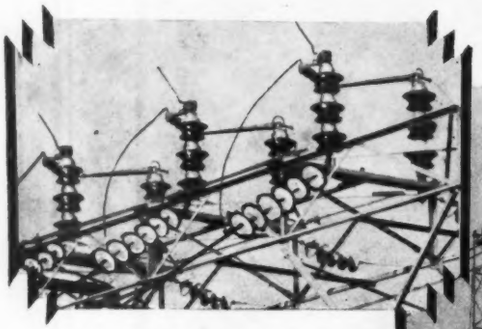
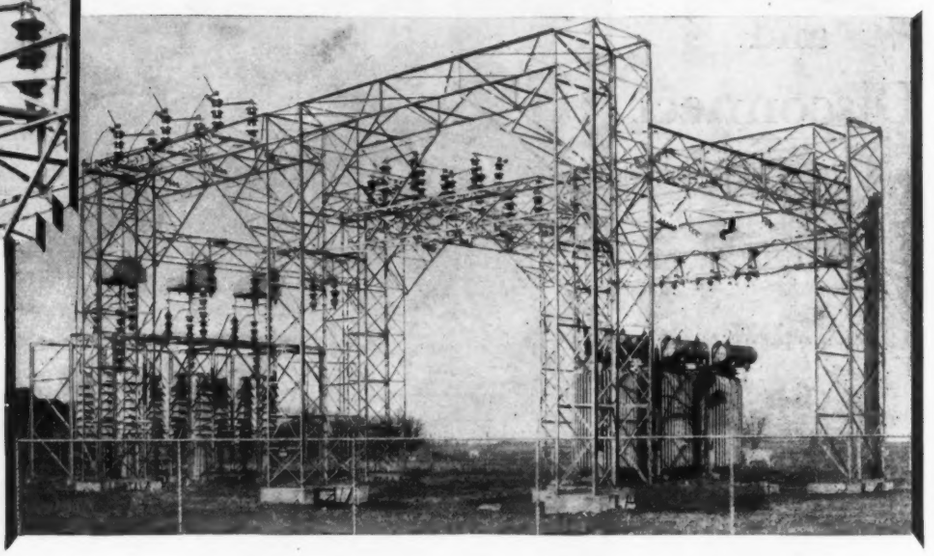
"Three E" 6600 TYPE Switches





SUPER fine apparatus for Super power Substation

Scene above is that of an important switching center on the Middle West Super Power System now under development. At this point power at 132,000 volts will be interchanged between three of the largest operating companies of this section in addition to stepping down a portion of it for nearby consumption. Apparatus that functions under all conditions of service is imperative on this job. Also *Service Value is to be considered. This is an exclusive "Three E" station less transformers and arresters. "Three E" designed it and furnished it from a single line diagram submitted by the customer.

Put your outdoor substation problems up to "Three E."

* *"Service Value"* = Low cost per year of service.

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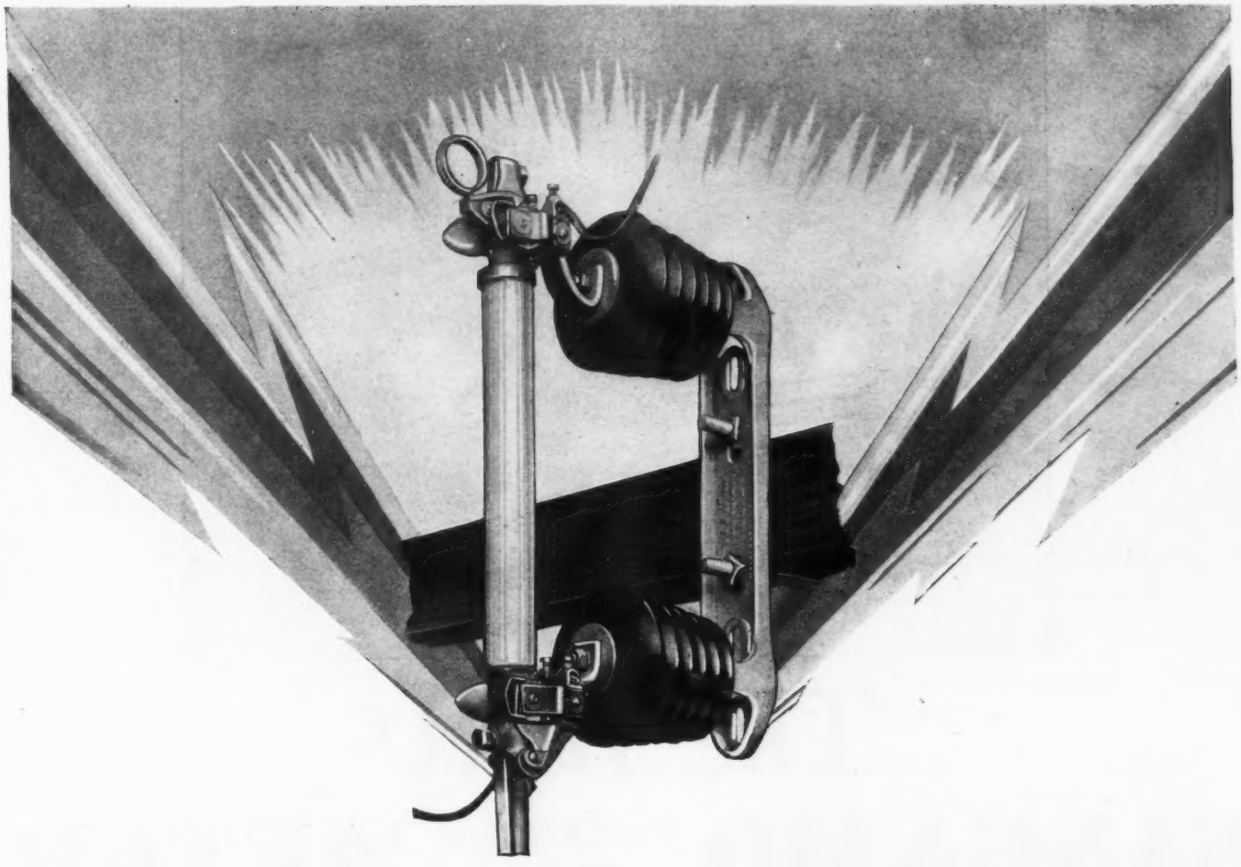

STURDY AND RELIABLE

KEARNEY FUSE SWITCHES

ON THOUSANDS of distribution systems Kearney Fuse Switches have performed an apparent miracle in giving protection. Built of sturdy materials, these switches withstand year around seasonal climatic changes. The performance of Kearney Fuse Switches is the result of applying correct engineering details and materials to an old problem. The simplicity of design, and sturdiness of materials used in Kearney Switching Equipment, are described in bulletin No. 312. Write today for your copy.

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Screw Type and Expansion Type Anchors, Solderless Service Connectors, Double Duty Fuse Cutouts, Farm Line Switching Equipment, Fuse Pullers, Guy Wire Clips, Hot Tap Clamps, Yokes, Economy Cable Clamps, Underground Cable Boxes.

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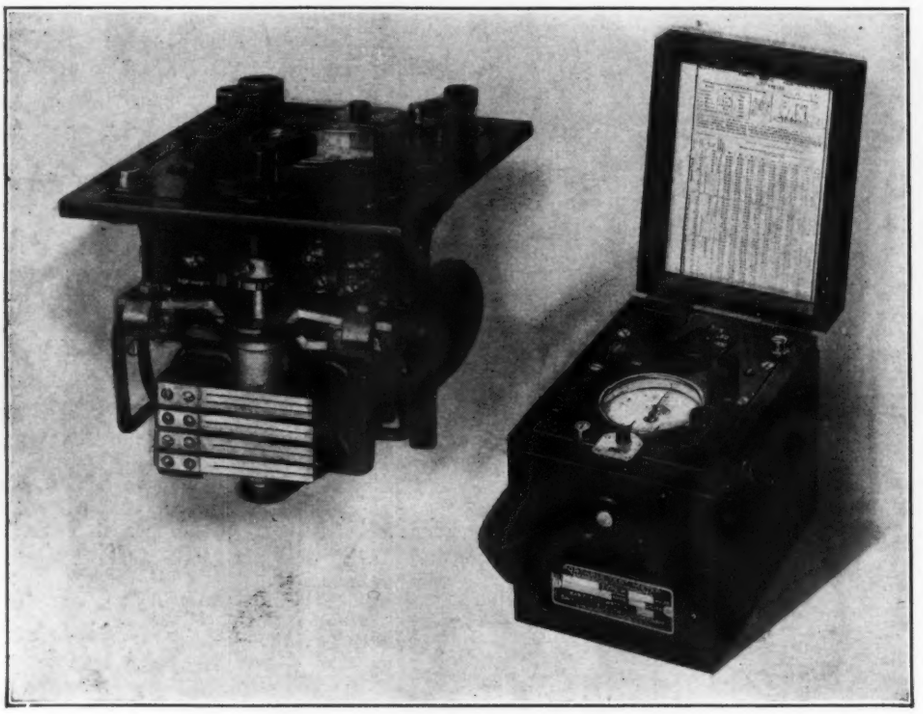

The new SANGAMO PORTABLE TEST METER

Is temperature compensated

LIKE the new Sangamo Type HC Service Meter, the new Sangamo Type HP Portable Test Meter is temperature compensated on both inductive and non-inductive load. This meter may be had with any standard test constant (5/24, 1/4, 3/10, 1/3).

The meter illustrated has six current ranges and two voltage ranges, without multiplier.

To insure a long life of undiminished accuracy under severe conditions, the lower main jewel bearing is spring supported and all step bearings in the register are jeweled. Every detail is worked out with the same regard for maintained accuracy. For example:

In the six-range meter (HP-6) the two highest current connections are made with two heavy laminated brushes pressing on opposite sides of the drum, thus equalizing the pressure, providing positive and uniform contact, and eliminating unbalanced forces with their consequent wear.

The Sangamo Portable Test Meter saves time and promotes accuracy in testing.

▼ ▼ ▼

There are three types of Sangamo Portable Test Meters. The HP-6 has six current ranges, namely, 1-5-10-25-50-100 amperes, the HP-3 has three current ranges, namely, 1-10-25 amperes or 1-5-15 amperes as specified and the HP-2 has two current ranges, namely, 1-10 or 1-5 or 5-10 amperes as specified. All have a rotating switch for changing from 110 to 220 volts. Multipliers for higher voltages can be supplied.

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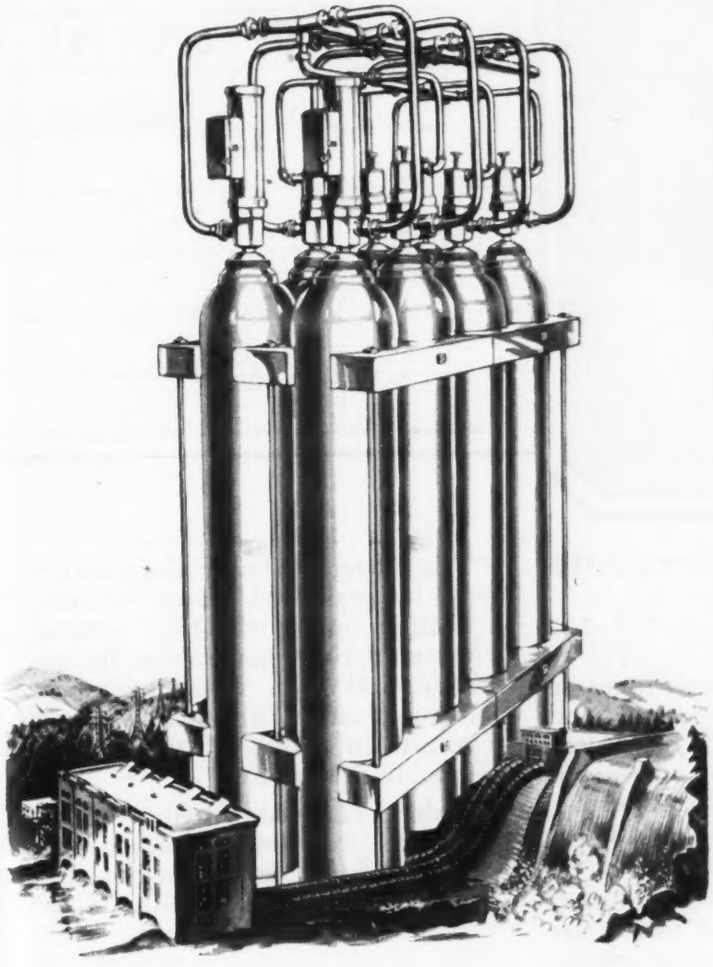
Makes every fire a small fire



The ALFITE System is ideal protection for either rotating or control equipment. It is a unit of American-La France and Foamite Protection—a product of the largest manufacturers of fire-fighting equipment in the world.

FIRE has no chance to spread, when an ALFITE System is on the job. Instantly, the fire area is flooded with harmless, fire-killing ALFITE (carbon dioxide) Gas, putting out the fire before it can make headway.

ALFITE Gas is a non-conductor of electricity. It cannot damage equipment or insulation. It may be applied by remote control, eliminating danger to employees through smoke and flame. Operation may be automatic, semi-automatic, or manual.

The ALFITE System is mechanically certain in its release of the gas. The system is simple in operation, moderate in cost. It is "tailor-made" for each risk by a group of engineers widely experienced in both central station operation and the use of carbon dioxide gas for protecting electrical equipment.

If you would like complete details of the ALFITE System, write us. An engineer will call, without obligation to you. American-La France and Foamite Corporation, Engineers and Manufacturers, Dept. N-11, Elmira, New York.

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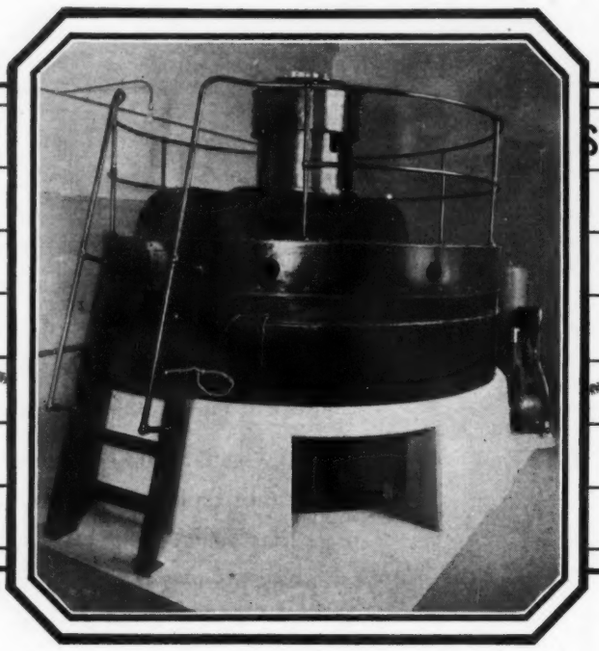
A Complete Engineering Service
For Extinguishing Fires

Your winter load curve is a "help wanted" *advertisement*



Hydro-electric generators of arc-welded steel - - - - -

WHEN the short winter days increase the load on your system and send the load curve to a new peak; when interconnection with other systems does not help because the peak loads are general--then is the time that hydro-electric reserves are wanted.

Westinghouse water-wheel generators, automatically controlled, will turn your peak loads to peak profits. Low maintenance costs and a high efficiency over the entire operating range enable you to turn waste energy of stream or river into productive electrical power.

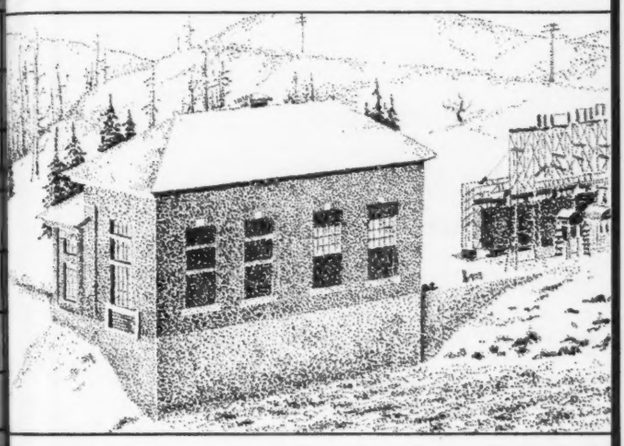
The Ottertail Power Company provided for its peak load season by recently installing one of the first vertical water-wheel driven generators in which the structural steel construction was used throughout. This form of construction results in a lighter, stronger and more flexible machine.

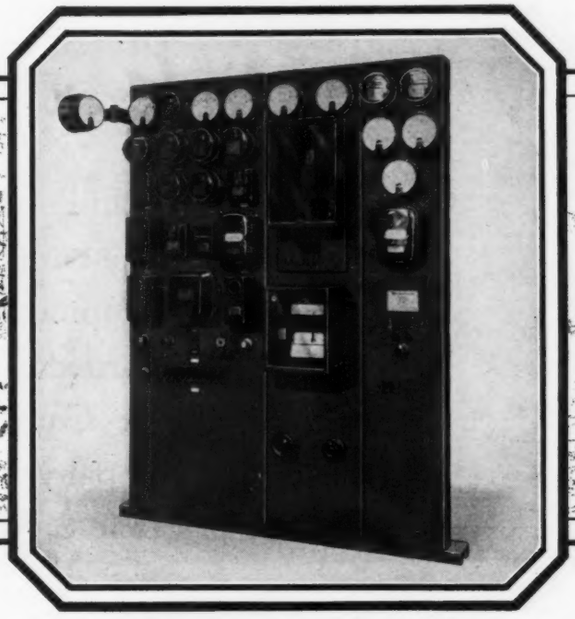
Orders received during the past nine months for eleven machines, totalling 320,000 kv-a. in the larger sized units, and 26 machines totalling 47,500 kv-a. in the smaller sized units, indicate that the Westinghouse structural design of vertical water-wheel generators has been very favorably received by the power industry.

Westinghouse

T 30196

Tie "peak profits" *to* "peak loads" *with automatic Hydro-electric stations*





Typical Westinghouse Automatic Steel Switchboard for the control of Hydro-Electric Generators.

DECEMBER--the month of shortest days in the year, has special significance to central stations. It's the month of peak loads on lighting and power circuits and can be made the month of peak profits by utilizing Westinghouse automatic switching equipment to control generators on small streams with hydro-electric possibilities.

This automatic equipment, by eliminating the necessity of maintaining attendants in out-of-the-way locations, brushes away the last remaining barrier to a profitable development of many excellent sources of hydro-electric power on small streams and assures sufficient generating stand-by equipment to meet peak load demands with resultant peak profits.

Three features of this equipment are:

Stretcher-level steel panels, a new automatic synchronizer, a governor mounted speed matcher.

Circular 1815 fully explains these and many other desirable features of Westinghouse automatic, hydro-electric switching equipment.

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Automatize with **Westinghouse**

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Wins Highest Award

The Charles A. Coffin Foundation Gold Medal, given annually to the company which has done most for the development of electric railway service, has been awarded for 1927 to the Virginia Electric and Power Company, W. E. Wood, President. This company is under the executive management of Stone & Webster, Inc.

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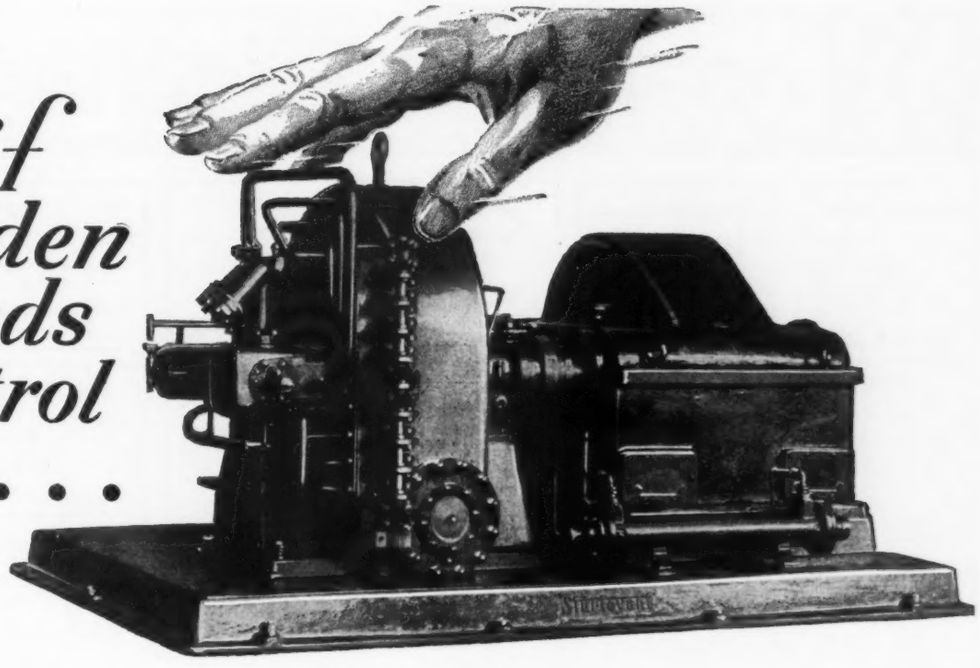
As if hidden hands control it . . . .



automatically this Auxiliary Steam Turbine adapts itself to varying load requirements

Instantly . . . when there is a call for more power, this turbine—*automatically*—provides additional nozzle area to meet it. When the load requirements decrease, nozzle area is reduced—*automatically!* It requires no manual operation. Control valves open and close to meet varying load requirements—just as if hidden hands control them.

The Sturtevant Automatic (Type 14) Steam Turbine is ideally suited to auxiliary drives. By it, generators, pumps, exciters, pulverizers, fans, are driven more economically. There is always an automatic saving of live steam which means a substantial return on the initial investment.

Investigate this new auxiliary turbine and its automatic control—an exclusive Sturtevant feature! Our nearest office will gladly furnish complete engineering data. Ask for Bulletin 353.

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Plants, Transmission Systems, Hotels, Apartments,
Office and Industrial Buildings, Railroads.
43 Exchange Place New York

The Trend Toward Economy—

All business today is struggling for lower competitive selling prices and lower production costs. Mass production, mergers and consolidations have played an important part in the national trend toward economy. However, economy cannot be effected unless it is practised both in the building of an industry and in the detailed methods which it employs for maintenance and growth.

The service of the expert consulting engineer is a real economy. With his knowledge of electrical problems and his wide and varied experience, he can usually reveal the points of waste and inefficiency that are costing you money and suggest inexpensive means for their elimination.

SEARCHLIGHT SECTION

USED MACHINERY & NEW—BUSINESS OPPORTUNITIES

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Positions Wanted, 4 cents a word, minimum 75 cents an insertion, payable in advance.
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Proposals, 40 cents a line an insertion.

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E.W.

POSITIONS VACANT

DRAFTSMEN—Large growing concern in metropolitan area has several openings for junior and senior draftsmen. Experience on wiring conduit and switchboard drafting. State age, education and experience. Box 195, Room 200, Times Bldg., New York City.

MECHANICAL engineers—Several openings in large, growing manufacturing concern in New Jersey metropolitan area for men who have had 4-5 years' experience on factory and plant layouts. Machine placement, material handling or experience on heating, lighting or ventilating system layouts. State age, education and experience in detail. Box 199, Room 200, Times Bldg., New York City.

ELECTRICIANS experienced on power house construction; give age, experience and salary expected. P-856, Electrical World, 7 So. Dearborn St., Chicago, Ill.

FOREMAN, for electrical repair shop; must be familiar with all classes of repair work. Salary $50.00 per week. Apply Electro Service, 116 36th Street, Union City, N. J.

MANUFACTURER of high-grade electrical apparatus for steel mills and other industries requires two 1925-26 graduate electrical engineers to be trained for sales department. Applications will be considered from men completing four year course and graduating in upper 25% of their class. P-814, Electrical World, 7 So. Dearborn St., Chicago, Ill.

WANTED—Man to take charge of meter department of local plant operating 5,000 meters. Must be experienced in the care, testing and repair of single and polyphase meters, current and potential transformers. Location, Western Michigan. Give detailed experience and salary expected. P-857, Electrical World, 7 South Dearborn St., Chicago, Ill.

Electrical Engineer—

Leading manufacturer is adding line of household electrical appliances. Wants capable man with designing and experimental department experience. Unusual opportunity for creative work. State age, educational qualifications, and experience. If possible send photograph. Replies confidential. Write

P. O. Box 945, Kansas City, Mo.

BE A METER ENGINEER

Get in the new profession. We can teach you Meter Engineering *by mail* at your own home during spare time. Successful graduates everywhere.

Earn $3,600.00 a Year

Central stations *must have Electrical Meter Engineers*. They pay high salaries. *Write today.* Just your name and address on a postal and we will send you full particulars free. Ft. Wayne Correspondence School, Dept. 46, Ft. Wayne, Ind.

EMPLOYMENT SERVICE

IF YOU are qualified for position between $2,500 and $25,000, and are receptive to negotiations for new connection, your response to this announcement is invited. The undersigned provides a thoroughly organized service, established nineteen years ago, to conduct confidential preliminaries, and assist the qualified man in locating the particular position he desires. Not a registration bureau. Retaining fee protected by refund provision, as stipulated in our agreement. Send name and address only for description of service. R. W. Bixby, Inc., 262 Main Street, Buffalo, N. Y.

$3,000-$30,000 men find our service effective in making connections individual. Confidential. Refund agreement. Not agency. Jacob Penn, Incorporated, 9 Park Place, New York.

POSITIONS WANTED

ARMATURE winder, expert on A.C. and D.C. motor repairs, windings and connections, desires steady location; some transformer reconnecting experience; can furnish best of reference; will go anywhere. PW-833, Electrical World, Guardian Bldg., Cleveland, Ohio.

POSITIONS WANTED

A PROMINENT organizer, constructor, operator and developer of public utilities, at present specializing in new business and who in six years, increased the business of a large holding company 75 per cent, solicits correspondence from companies desiring to secure the services of this type of man. PW-835, Electrical World, Tenth Ave. at 36th St., New York.

AS STREET lighting sales engineer with public utility operating in a number of municipalities; experienced; available March 1. PW-853, Electrical World, Tenth Ave. at 36th St., New York.

CABLE splicer, age 32, now employed; references; 7 years' experience; do any work up to 15,000 volts; opportunity for advancement considered most important. PW-852, Electrical World, 7 South Dearborn St., Chicago, Ill.

TO HELP YOU

LOCATE COMPETENT MEN

"Searchlight" Advertising

WANTED

SALES REPRESENTATIVES

Burndy Engineering Co. Inc. invites correspondence from agents for representation of advanced lines of High Tension Bus Equipment. Exclusive territory open from Jan. 1, 1929 and includes all states excepting California and Southeastern Group.

BURNDY ENGINEERING CO. INC

10 EAST 43RD STREET · NEW YORK

Telephones: Palisade 2600-2601

MOTOR GENERATOR SETS

1—250 kw., 250 v , G.E. Generator, 3 ph., 60 cy., 2200 v. synchronous motor.
200 kw., 600 r.p.m., 250 v. Gen., 3 ph., 60 cy., 440–2200-v. synchronous motor.
150 kw., 600 r.p.m., 250 v. Gen., 3 ph., 60 cy., 220–440 v. G.E. synchronous motor.
1—125 kw., 250 v. Westinghouse synchronous generator motor set.
1—100 kw., 125 v., D.C., 220–440 A.C., G.E. synchronous motor generator set.
100 kw., 250 v. Gen., 900 r.p.m., 2200 synchronous motor.
1—75 kw., 250 v. Generator, 3 ph., 60 cy., 2200 v. synchronous motor.
60 kw., 125 v., C. W., 3 ph., 60 cy., 220–440 v. motor.
1—50 kw., 250 v. Westinghouse, 3 ph., 60 cy , 220–440 v.
1—37½ kw., 900 rev., 110 v., D.C., on same base with 60-hp. Lincoln 220 v., sq. cage motor.
10-20-25-40 kw., 125 v. Exciter Sets.
10-20-30 kw. Balancer Sets.
3-5 kw. Battery Charging Sets.

TRANSFORMERS

4—150 kw., 4150 v., 120–240 Pittsburgh Oil Cooled Transformers.
15—5 kw., 30 kw., 3 ph. Pole Type, 2200–1100 440–220–110 G.E.

A. C. GENERATORS

No.	Kw.	Rpm.	Volts	Ph.	Type
1	400	600	2200	3	GE "B"
1	300	450	2300	3	G.E.P.
1	250	600	440	3	Westg.
2	125	900	2300	3	Cr.-Wh.
2	100	900	230/2300	3	G.E.
1	75	600	220	3	Westg.
1	75	900	2300	3	G.E.
1	50	1200	220–440	3	G.E.
1	50	1200	2300	3	G.E.
1	30	1200	220–2200	3	G.E.

MOTORS—3 PHASE, 60 CYCLE

	Hp.	Rpm.	Volts	Type
1	500	600	2200/4150	G.E. syn.
1	500	360	220/440	Westg. HF.
1	400	450	2200	G.E. synch.
1	300	300	2200	Westghse. synch.
1	250	600	220/440	Westghse. synch.
1	250	600	440/2200	G. E. synch.
3	200	514	4150/2300	G. E. synch.
1	200	450	440/2200	G. E. sl. rg.
1	180	400	440/2300	Burke sl. rg. 3 brg.
1	150	900	2300	G. E. synch.
4	150	514	2200	Westghse. sl. rg.
1	150	1800	2200	Westg. sq.cg. motor
1	100	900	440/2200	G. E. sq. cg.
1	100	900	220/440/2200	Westg. sq. cg.
1	75	600	220	G. E. sq. cg.
1	75	600	220	Fair.-M. sl. rg.
1	75	490	440	Allis-Chal. sl. rg.
1	75	900	2200	G. E. KT.
1	60	1200	220	G. E. sl. rg.
1	60	300	220/440/2300	Fair.-M. synch.
1	50	600	2200	G.E. MT. sl. rg.
1	50	900	2200	G. E. B.
1	50	1200	220/440	Wagner sl. rg.
1	40	1700	220/440	Westghse. sl. rg.
1	25	900	440/2200	Cr.-Wheeler
1	25	1200	440	G. E. K.
1	25	900	220	West C. S.

(2 Phase Motors on request)

BRAND NEW MOTORS

No.	Hp.	Rpm	Volts	Type	
5	7½	900	220–440	Gen. Electric	MT
1	10	1200	220–440	Gen. Electric	MT
2	15	1200	220–440	Gen. Electric	MT
1	15	1200	220–440	Gen. Electric	KT
4	25	600	220–440	Gen. Electric	KT
5	25	900	220–440	Gen. Electric	KT
1	30	900	220–440	Gen. Electric	KT
2	30	1200	220–440	Gen. Electric	KT
1	40	1200	220–440	Gen. Electric	MT
1	40	900	220–440	Gen. Electric	KT
1	40	1200	220–440	Gen. Electric	KT
1	60	720	220–440	Gen. Electric	KT

D. C. GENERATORS—250 VOLT

No.	Kw.	Rpm.	Type
1	200	600	G. E.
1	150	600	G. E.
1	125	600	Cr. Wheeler
1	100	720	G. E.
1	75	450	Diehl
1	50	600	Westghse.
1	30	1000	Westghse.

(Smaller sizes on request)

D. C. GENERATORS—125 VOLT

5, 10, 20, 22, 35, 50, 2-100 kw.
3—21 kw. 1250 r.p.m. Sprague

D. C. MOTORS—230 VOLT

No.	Hp.	Rpm.	Type
1	250	550	G.E.
1	150	600	G. E.
1	150	1100	West. SK
1	125	550	Cr. Wheeler
1	100	625	Wstg. type S
1	80	500	Allis-Chal.
2	75	475	Wstg. type S
1	50	560	Wstg. SK
1	50	200	Diehl
1	50	650	Sprague
1	40	400	Diehl
1	40	1300	Diehl
1	35	200	Diehl
1	35	700	Cr. Wheeler
1	35	420	Diehl
1	20	665	Diehl
1	20	200	Diehl
1	20	900	Diehl
2	15	1050	Cr.-Wh. CM
8	10	375/750	Wstg S.v.sp.
	10	1350	Rochester

(Smaller sizes on request)

D. C. MOTORS—125 VOLT

1	125	575	G. E.
1	100	600	G. E.
1	80	600	G. E.
3	25	1200	Sprague
1	20	650	G. E.
1	15	775	SK Wstghse

POSITIONS WANTED

ELECTRICAL engineer now employed; seventeen years' experience construction and sales; now specializing on treated poles and timber, desires connection with power company as timber man. PW-821, Electrical World, 7 South Dearborn St., Chicago, Ill.

ELECTRICAL graduate, seven years' experience, desires service or investigation work. PW-830, Electrical World, Tenth Ave. at 36th St., New York.

ELECTRICIAN, experienced in power house, substation and industrial installation. Capable of interpreting blueprints and directing installation. Semi-technical education. Excellent references. Age 30. Available on reasonable notice. Will go anywhere. PW-851, Electrical World, Tenth Ave. at 36th St., New York.

METER MAN, technical graduate in electrical engineering; eight years' experience in supervising, testing and maintenance of meters and instruments. PW-837, Electrical World, Tenth Ave. at 36th St., New York.

SALESMEN WANTED

Two Experienced Electric Motor Salesmen Wanted by old established electrical manufacturing company, location, Middle West; state age, education, experience and salary expected. SW-843, Electrical World, Tenth Ave. at 36th St., New York.

EDUCATIONAL

Bliss Electrical School

Condensed course in electrical engineering; complete in one year; for men of character, ambition and limited time; theoretical principles and practical applications of electricity; mathematics, steam and gas engines, mechanical drawing, extensive shop work; construction, installation, testing; fireproof dormitories, dining hall, laboratories, shops; established in 1893; catalog on request. 242 Takoma Ave., Washington, D. C.

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WANTED

WANTED FOR RE-SALE

100 HP. SLIP RING

Slow speed motor, Allis-Chalmers preferred, 3 ph., 60 cy., 2,200 volts, with primary oil circuit breaker, and with drum type control, rails and pulley. Apply

STARK ELECTRIC COMPANY
York and William Sts., Baltimore, Md.

Rotary Converters Wanted

We would be interested in receiving information on 60 cycle rotary converters of 500 KW. capacity or larger. Those with 33 KV. transformers preferred. Must be in operating condition. Give complete data with prices in original letter.

Illinois Terminal Railroad System
Springfield, Ill.

Watch the SEARCHLIGHT SECTION for Equipment-Opportunities

"JOHN A." STEWART ELECTRIC CO

(Established 1897)
Vine and Water Sts., Cincinnati, O.

SUPPLYING GOOD, USED STEAM AND ELECTRICAL EQUIPMENT FOR OVER 30 YEARS.

Let "John A's" experience save you money. Immediate shipment on many items from our warehouse.

FOR SALE

GENERATING UNIT

1—400 Kw. 80° P. F. G. E. Co., 2300 volt, 3 phase, 60 cycle Generator. This Generator driven by and direct connected to a Philadelphia Iron Works Cross Compound Engine, suitable for 150 lbs. steam. Unit is complete with Low Level jet condenser and pump. Engine Cyl.: H.P. 18-in.; L. P. 36-in. Stroke 42-in.

Speed is 100 r.p.m. Machine is in first class operating condition and can be seen in operation for the next 30 days.

If purchaser will dismantle and load, we will make a very attractive price, so as to dispose of this unit at once.

CITY OF NEW BERN, N. C.
Water and Light Dept.

This transformer offer should interest you

Most important to you is the complete assurance of correct workmanship and materials which our 20 years' transformer work insures. Testimony of some of the largest power companies in the East support this assurance. (References will be sent on request). The latest types of transformers are available in our stock of some 5,000 units. All sizes 1 to 1,000 kva.—from 110 to 66,000 volts.

Each has passed A.I.E.E. standards. Each is ready for hard service—immediately.

Remember, too, the direct saving of from 30 to 60% over the cost of brand new equipment.

Write for our Monthly Bulletin. It tells the whole story. If you need transformers—one or a 100, you need this Bulletin.

WE BUY MODERN TYPE TRANSFORMERS—ANY SIZE—ANY QUANTITY

The ELECTRIC SERVICE CO. Inc.

America's Used Transformer Clearing House

212 Walnut Street Cincinnati, Ohio

TRANSFORMERS

3—2000 KVA. Gen. Elec. 48,000 vs. prim. 24,000 vs. secy.
3—1000 KVA. Westinghouse 6,600 vs. prim., 2,200 vs. secy.
1—750 KVA. Pittsburgh OISC, 40 deg. Furnace Transformer 25000/12500 vs. prim. 280/260/240/220/200/140/130/120/110/100 vs. secy.
3—500 KVA. Gen. Elec. H., Form L, 11,000 vs. prim. 2400 sec.
3—400 KVA. Pittsburgh 13,800 vs. prim., 2,300 vs. secy.
2—400 KVA. Gen. Elec Type H, Form LTQ, 6,900 vs., 3 ph. prim. to 230/460 vs. 2 ph. secy.
3—350 KVA. Gen. Elec. 13,200/6,600 vs. prim., 460 vs. secy.
2—333 KVA. Pittsburgh 2200 vs. prim. 230/460 vs. secy.
3—333 KVA. Allis-Chalmers 2300 vs. prim., 460 vs. secy.
2—330 KVA. Gen. Elec. 6600 vs. prim., 120/240 vs. secy.
3—300 KVA. Pittsburgh 2200 vs. prim., 440/220 vs. secy.
3—250 KVA. Gen. Elec. Type H, Form KS, 2415/2300/2185 vs. prim., 230/115, secy.
3—200 KVA. Gen. Elec. Type H, Form KDD, 11500/10925/10350 vs. prim., 2400, secy.
3—200 KVA. Gen. Elec. H, 13,200 vs. prim., 2300/4000 Y, secy.
3—200 KVA. Pittsburgh 13,200 vs. prim. 230/460 vs. secy.
3—150 KVA. Gen. Elec. 2200 vs. prim., 120/240 vs. secy., Type H, Form RP.
3—110 KVA. Westgh. 13,200 vs. prim., 440/220 vs. secy.
3—100 KVA. Westgh. 2400 vs. prim., 440 vs. secy.
3—100 KVA. Pittsburgh 2200/2300/2400 vs. prim. 220/230/240 vs. secy.
3—100 KVA. Westgh. Type SK, 13,200/26,400 vs. prim. 2300 vs. secy.
3—100 KVA. Pittsburgh 2200 vs. prim., 220/440 vs. secy.
3—100 KVA. Gen. Elec. H, Form KR, 13800/6900 vs. prim., 230/460 vs. secy.
3—100 KVA. Westgh. SK, 13,800 vs. prim., 440/220 vs. secy.
3—100 KVA. Gen. Elec. H, Form RP, 6600/13200/11880 vs. prim. 440/545/605 vs. secy.
3—100 KVA. Gen. Elec. HJ, Form KD 33000 vs. prim. 445 vs. secy.
3—50 KVA. Gen. Elec. H, K, 2200 vs. prim. 110/220 vs. secy.
3—25 KVA. Westinghouse SK, 22,000 vs. prim. 2200 vs. secy.
2—25 KVA. Allis-Chalmers 2300 vs. prim. 220/110 vs. secy.

ARCHER & BALDWIN, Inc.

126 Liberty St., New York City. Telephone—Rector 4025

LAND

MOTOR BARGAINS

New and Used Selected Bargains

Squirrel Cage Motors
(3 ph. 60 cy., 220/440)

15	G. E.	1800	K. T.
15	G. E.	1200	K. T.
15	C. W.	1200	
15	Westghse.	900	C. S.
15	Wagner	900	B. N.
15	G. E.	1200	K. T. E.
10	G. E.	1800	K. T.
10	G. E.	1200	K. T.
10	Westghse.	1200	C. S.
10	Allis-Chal.	900	
10	G. E.	900	K. T.
10	G. E.	720	C. S.
10	G. E.	600	K. T.

Large stock of Motors from ¼ to 300 hp. Also Generators and Motor Generator Sets of all characteristics.

L. J. LAND, 207 Centre St., N. Y. C.

SELECT BARGAINS

Slip Ring Motors, 3 Ph., 60 Cy.

1—200-hp. Westing., Type CW, 220/440 volt, 514 r.p.m.
2—200-hp. Fairbanks-Morse, Type BV, 220/440 volt, 600 r.p.m.
2—150-hp. Gen. Elec. Type 1 Form M 220/440 volt 580 r.p.m.
1—104 hp. Gen. Elec. 1 Form M, 220/440 volt, 860 r.p.m.
1—100-hp. Burke Elec. Type EMV, 2200 volt, 900 r.p.m.
1—75-hp. Gen. Elec. Type MT, 220/440 volt, 860 r.p.m.

Synchronous Motor Generator Sets

5 New Westinghouse 3 Bearing, A.C., Type G, 50 Kva., 220 v., 3 ph., 60 cy., 1200 r.p.m., D.C., Type SK-150L, 125 volt.
2—Sets as Above Except D.C., SK-150, 250 volt.

See last week's listing

MOTORS—GENERATORS—TRANSFORMERS AND OTHER ELECTRICAL EQUIPMENT

Belyea Co., Inc., 151 W. 18th St. New York City

REBUILT—GUARANTEED

MOTOR GENERATORS

1—240 KW., 250 volt, 1200 r.p.m., type MPC, General Elec. compound wound interpole generator direct connected to a 330 KVA. (350 HP.), 3 phase 60 cycle, 2300 volt, 1200 r.p.m., .85 P.F., type ATI, General Elec. synchronous motor complete with panels. Machine mounted on common cast iron base. Price, $2,750.
1—150 KW, 250 volt, Sprague generator to a 200 HP., 3 phase, 60 cycle, 2300 volt, 600 r.p.m., type ATI General Elec. synchronous motor with belt driven exciter, flexible coupling rheostat for generator and starter for motor. Price, $1,400.
1—150 KW. Westinghouse type SK191, compound wound, 550 volt, 900 r.p.m., direct connected to 225 HP. Westinghouse synchronous motor, 3 phase, 60 cycle, 4000/2300 volt, 900 r.p.m., with direct connected exciter, type SK40, 3 bearing, on common cast iron base without accessories. Price, $1,500.

ROTARY CONVERTERS

1—450 KW, 55 deg., 300 KW, 35 deg., 600 volt, 1200 r.p.m., type HCC, form P, Gen. Elec. rotary converter with 3 General Elec. transformers, 150 KW, 60 deg., 2 hours, 33,000 volts primary, 60 cycle with choke coils, disconnect switches, lightning arresters and a.c. and d.c. panels.
1—300 KW, 275 volt, 1200 r.p.m., compound wound, interpole, type HCC Gen. Elec. with transformers for 3 ph., 60 cy., 2300 v., a.c. and d.c. panels.

Turbo Generators, Various Sizes. Also Large Stock Transformers, Engine Driven Units, Motor Generators, Motors, Dynamos of all Descriptions.

Inquiries Solicited.

GEORGE SACHSENMAIER COMPANY

8401 Hegerman St., Holmesburg, Phila., Pa.

TRANSFORMERS

500 Transformers, General Electric and Westinghouse up to 100 KVA built in 1920 to 1926 at worth-while prices. Send for list.

GEORGE SACHSENMAIER COMPANY

8401 Hegerman St., Holmesburg, Phila., Pa.

"Opportunity" Advertising:

Think *"Searchlight"* First!

HIGH GRADE STANDARD EQUIPMENT

Slip Ring Motors—3 Ph., 60 Cy.

Hp.	Volts	Make	Speed
400	2200-550	Whse.	450
225	220-440	G.E.	450
200	2200	G.E.	600
150	220-440	G.E.	720
150	220-440-550	G.E.	600
125	2200	G.E.	1200
125	220-440	G.E.	600
100	2200	G.E.	900
100	440-220	G.E.	720
100	440-220	G.E.	600
100	440-220	G.E.	900
75	220-440	G.E.	720
75	440-220	G.E.	900
75	550	G.E.	720
50	550	G.E.	514
50	220-440	G.E.	900
35	550	G.E.	900
35	220-440	G.E.	900
25	220-440	G.E.	1200
25	2200	G.E.	1200
20	550	Whse.	600

Synchronous Motors—3 Ph., 60 Cy.

Hp.	Volts	Make	Speed
240	2200-440	G.E.	720
135	2200-550	G.E.	900
110	2200	G.E.	900
80	2200-440-220	G.E.	1200

Direct Current Motors

Hp.	Volts	Speed	Make	Type
225	230	760	Westghse.	SK
120	230	720	Westghse.	SK
60	230	1050	General Electric	RC
50	600	1450	Westghse.	SK
35	115	700	General Electric	DLC
30	115	1150	General Electric	RC

Direct Current Generators

200	250	850	Westghse.	SK
125	250	650	Western Electric	L
100	250	625	Westghse.	SK
75	250	850	General Electric	CLB
65	125	800	Westghse.	SK
35	125	850	General Electric	DLC
6	125	300	Westghse.	SK

Sq. Ca. Motors—3 Ph., 60 Cy.

150	440-220	G.E.	1200
100	550	G.E.	1800
100	220-440	G.E.	1800
100	220-440	G.E.	900
75	220-440	G.E.	900
75	220-440	G.E.	720
75	220-440	G.E.	1200
75	2200	Allis-Chal.	1200
50	220-440	G.E.	900
50	550	G.E.	900
40	220-440	G.E.	1200

Motor Generator Sets

1—220-kw., 250-v., 514-r.p.m., Westghse. D.C. with 300-kva., 2200-v., 3-ph., 60-cy., syn.
1—150-kw., 250-125-v., 3 wire, 720-r.p.m. Crocker-Wheeler Generator connected to 225-hp., 2200-440-v., 3-ph., 60-cy., syn. G. E. motor.
1—100-kw., 125-v., 1200-r.p.m., G. E. Type MPC; D.C. Generator connected to 125-kva. G. E. Type ATI, 440-220-v., 3-ph., 60-cy., syn. motor.
1—50-kw., 125-v., 1150-r.p.m. G. E. Type RC, D.C. Generator connected to 75 hp. G. E. Type KT, 220-440-v., 3-ph., 60-cy. motor.
1—50-kw., 125-v., 1150-r.p.m. Westghse. S.K. D.C. Generator connected to 75 hp. Westghse Type CS 2200-v., 3-ph., 60-cy. motor.

A. C. Generators

1—187-kva., 720-r.p.m., 2200-440-220-v., 3-ph., 60-cy., G. E. belted exciter.
1—112 ½-kva., 900-r.p.m., 2200-v., 3-ph., 60-cy. G.E. direct connected exciter.
1—100-kw., 900-r.p.m., 2200-v., 3-ph., 60-cy., G. E. belted exciter.
1—75-kw., 900-r.p.m., 480-240-v., 3-ph., 60-cy G. E., belted exciter.
1—75-kw., 1200-r.p.m., 2200-480-240-v., 3-ph. 60-cy., G. E. belted exciter.

STEPHEN HALL & CO., INC., 7th and Adams Sts., HOBOKEN, N. J.

USED MOTORS

FIRST CLASS CONDITION

1—800 hp. Westinghouse Type C, 200 r.p.m., 2,000 v., 3 ph., 60 cy.
1—750 hp., G. E. Type I, Form L.M., 300 r.p.m., 2,200 v., 3 ph., 60 cy.
1—250 hp., G. E., Type I, Form K, 514 r.p.m.
3—250 hp., 2,200 v., 60 cy., 3 ph., Type C Westinghouse Motors.
1—200 hp., Type C, Westinghouse (2 speeds) a 2 set winding, one for 300 r.p.m. synchronous speed and one for 600 r.p.m.
1—200 hp., G. E., Slip ring Type I, Form M, 2,200 v., 575 r.p.m.

VERTICAL MOTORS

1—75 hp. Westinghouse, Type CS, 440 v., 870 r.p.m.
1—100 hp. G. E., Type KT, Form A, 440 v., 1,160 r.p.m.
2—100 hp. G. E., Type I, Form K, 440 v., 1,200 r.p.m.
1—150 hp. Westinghouse CCL, 2,200 v., 1,165 r.p.m.
1—150 hp. G. E., Type I, Form K, 2,200 v., 1,175 r.p.m.
2—200 hp. G. E., Type I, Form K, 440 v., 1,200 r.p.m.

Send for Bulletin No. 400 containing complete list of equipment.

United Commercial Co., Inc.
234 Steuart Street, San Francisco, Calif.

We have at Boise, Idaho

1 Westinghouse Motor Generator Set—as follows:
1—750-kw. Generator Direct Current, 575 v. 1300 amp., 514 r.p.m. Serial No. 1235252—1911. Direct connected to
1—1080 hp. Synchronous Motor. 4,000 v., 60 cy., 3 ph., 121 amp. Per Ph. 514 r.p.m. Serial Number 1235250. Direct Connected to
1—16-kw. D.C. Generator (Exciter). 125 v. 128 amp. 514 r.p.m. No. 140 Type SK Compound Wound. Serial No. 1235821.
1 Westinhouse Motor Generator Set—as follows:
1—150-kw. D.C. Generator. 550 v. 585 r.p.m. Serial No. 462029. Direct connected to
1—Induction Motor Type CCL. 220 hp. 4,000 v., 60 cy., 3 ph., 48 amps. per terminal. 585 r.p.m. Serial No. 461857.
4 Westinghouse Rotary Converter Sets. 300 kw., 600 v., 500 amps., 3 ph., 60 cy., 720 r.p.m. Serial No. 488150. Direct Connected to
1—Induction Type C Motor. Constant Speed. 29 hp., 60 v., 720 r.p.m. Serial No. 488154.
1—Crocker-Wheeler Motor Generator Set. 300 kw.—Complete.
9 Westinghouse 100 kw. Transformers. 44,000 and 393 v.
3 Westinghouse 110 kw. Transformers. 44,000 and 393 v.
1 Crocker-Wheeler Auto. Transformer. Type F. Size 81F. 3 ph., 2300 v.
2 Westinghouse 44000 v. Circuit Breakers. Type L.
18 Westinghouse Disconnectors. Type M, 4400 v., 300 amp.
2 Sets Westinghouse Low Equiv. Lightning Arresters. 44000 v.
6 Westinghouse Choke Coils. Type OISCI pole—44000 v.
25 Panels Westinghouse Switchboard.

Ask us for prices.

The Perry Buxton Doane Co.
Philadelphia, Pa.

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Having recently moved one of our factories from Milwaukee to Niagara Falls, N. Y., we have the following transformers for sale:

2—250 kva. Kuhlman 13,200 primary 480/240 secondary.
1—100 kva. Kuhlman 13,800 primary 480/240/120 secondary.
2—50 kva. Allis Chalmers 4,000 primary 440 secondary.
4—60 kva. Kuhlman 4,500 primary, 500 secondary.

All above in first class condition.

The Carborundum Company
Niagara Falls, N. Y.

FOR SALE

1—Westinghouse, 780 KVA, Turbo Generator Set, 440 volt, 3 phase, 60 cycle, low pressure.
2—200 H.P. Ames HRT Boilers, 150 lb., A.S.M.E. Mass. Standard.
1—250 H.P. Scotch Marine Boiler, 160 lb.

Consolidated Products Co., Inc.
18-21 Park Row, N. Y. C.
Barclay 0600

Variable Speed Motor

230 V. D.C.

70 hp., 225/450 r.p.m., General Electric, type CLC-120, Form B, variable speed, 230 v. D.C. Motor, complete with sliding base, pulley and control panel. Good as new. Never in service.

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350 H.P. Busch Diesel Unit

350 hp. Busch Sultzer Bros. Diesel Oil Engine direct connected to 250 volt direct current Generator. Practically new, kept like a fine watch; substitute alternator available.

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The Professional Consultant brings to you a wide and varied experience on which to base a solution to your business troubles.

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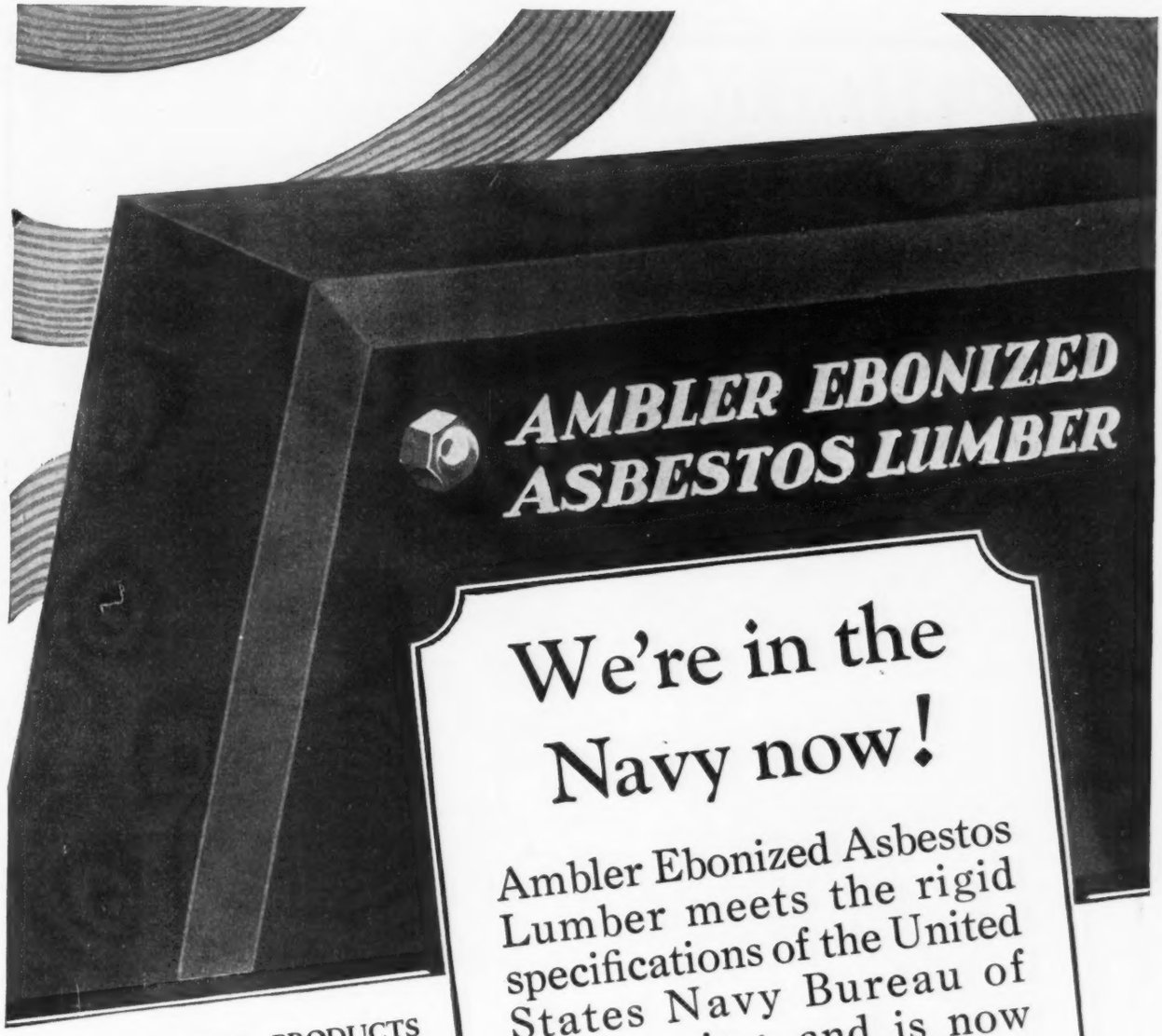

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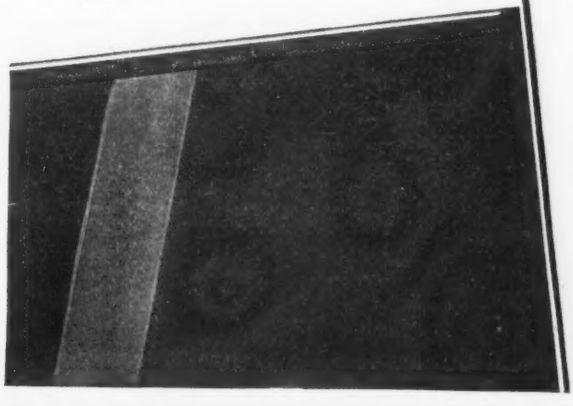

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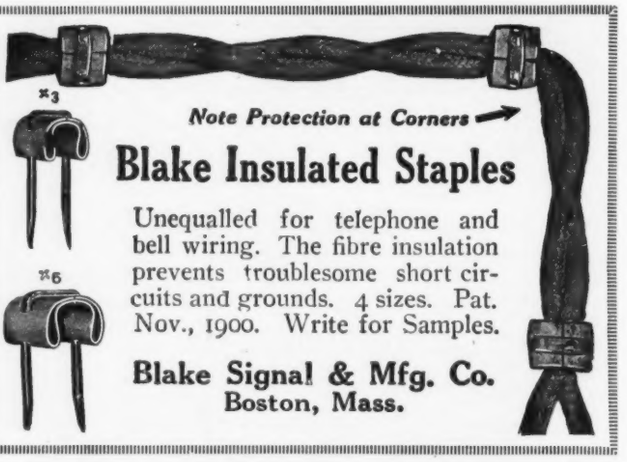

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Unequalled for telephone and bell wiring. The fibre insulation prevents troublesome short circuits and grounds. 4 sizes. Pat. Nov., 1900. Write for Samples.

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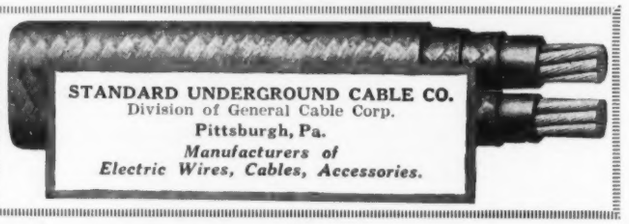

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Division of General Cable Corp.
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Manufacturers of
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Best for Switchboards

Monson Slate is recognized throughout the industry for its uniform high quality.

To meet a rapidly increasing demand we have expanded our producing facilities to double their former capacity.

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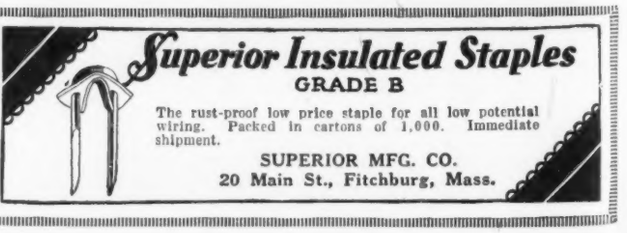

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GRADE B

The rust-proof low price staple for all low potential wiring. Packed in cartons of 1,000. Immediate shipment.

SUPERIOR MFG. CO.
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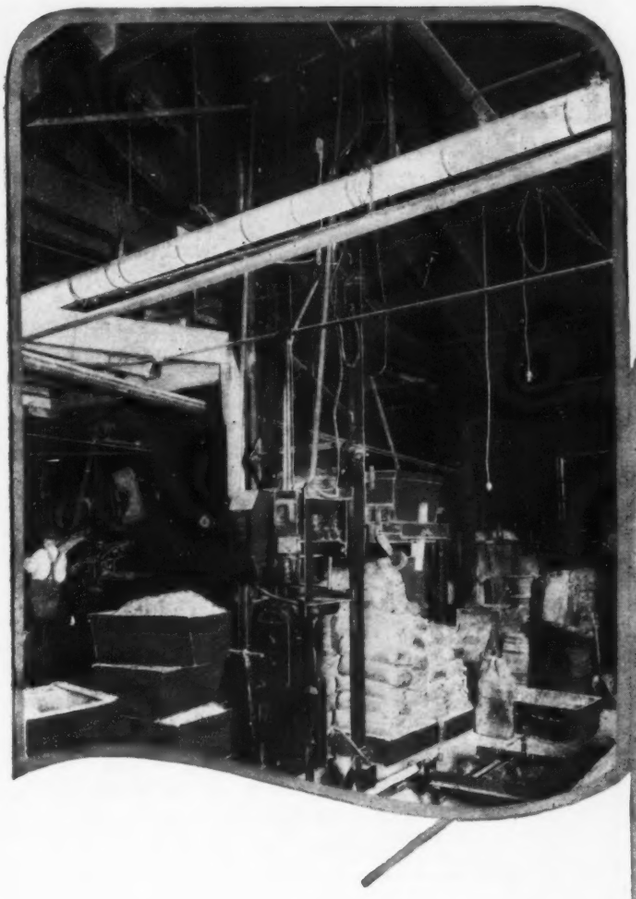

Good Portable Cord Keeps good portable electric equipment in operation

TIREX

Portable Cord for heavy duty service

To give the service it is capable of giving, a good portable electric tool or piece of apparatus should be serviced with a portable cord that will parallel the performance of the product to which it is attached.

TIREX Portable Cord is primarily a hard service cord, constructed and manufactured so as to embody every principle and feature essential to long life and efficient performance under hard service conditions.

TIREX is unusually flexible and will not kink, fray or crack despite constant bending and twisting. A smooth rubber-sheath possessing toughness and wear-resisting qualities to a high degree protects the cord against hard and abusive treatment. Oils, acids, greases and water have very little effect upon the tough rubber-sheath.

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Wire from No. 20 to No. 30 B & S, and from No. 30 to No. 36 B & S.
—Spools, 3-in. to 6-in. heads.
—Cam Traverse, 2½ to 3½ in.
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CLEAN INSIDE—Made in our own open hearth furnaces, using the latest and most progressive methods to get good clean steel.

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RESULTS—Better magnetic performance, best die service.

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Successors to the Mansfield Sheet & Tin Plate Co.

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In Every Commercial Form

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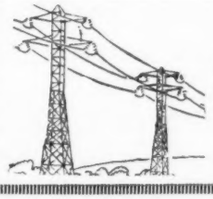

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To Meet Every Requirement
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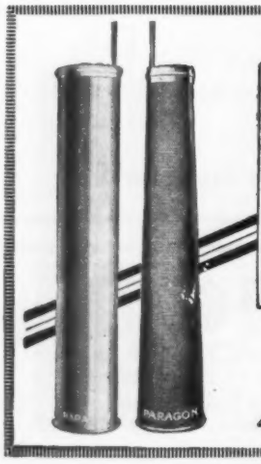

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Heavy continuous copper throughout. All joints spot welded. Insure durability, highest conductivity, lowest resistance to ground, and ample capacity. Inexpensive and easily installed with a post hole auger.
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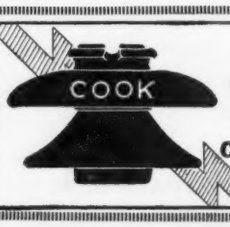

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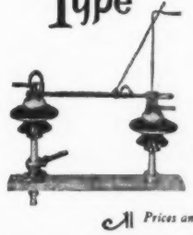

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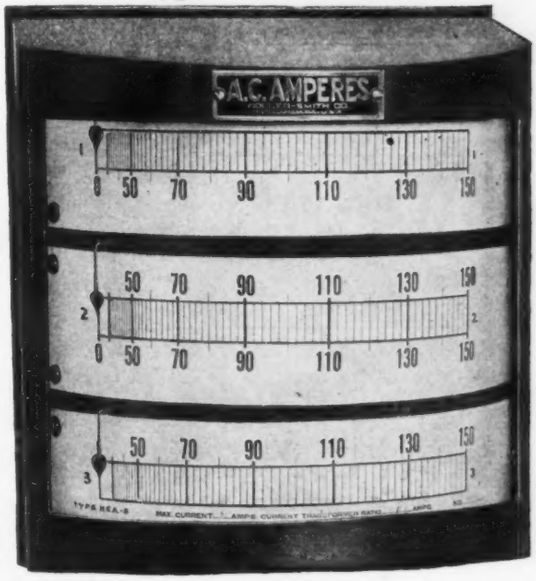
ROLLER-SMITH Announces a New Polyphase Ammeter



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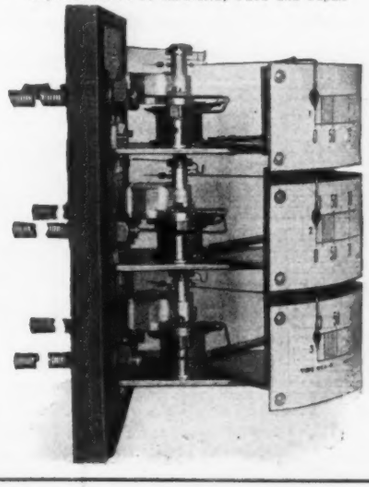

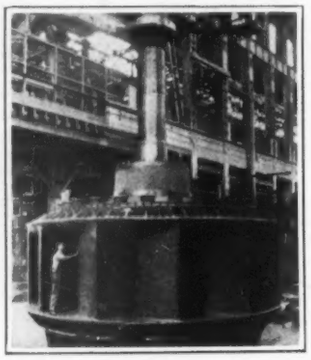

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Francis and High Speed

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for
THE CENTRAL STATION
Let us help increase your revenue
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Special Sizes and Shapes

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General Offices and Plants
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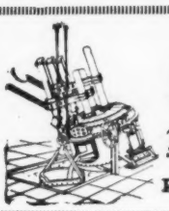

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Ten Standard Sizes ½ to 24 Tons Capacity
Most Rapid and efficient for making
Tool Steels, Alloy Steels, Forging Steels
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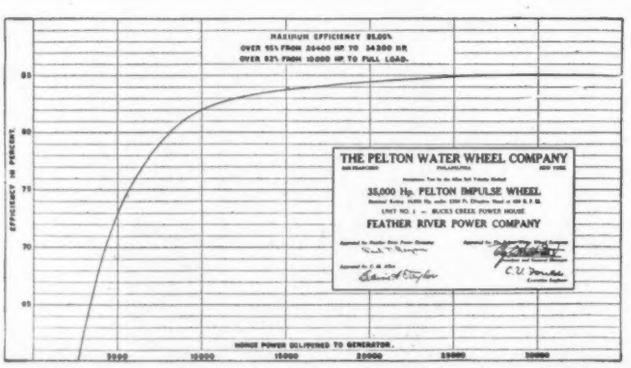
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HORSE POWER DELIVERED TO GENERATOR.
THE PELTON WATER WHEEL COMPANY
35,000 Hp. PELTON IMPULSE WHEEL
UNIT NO. 1 — BUCKS CREEK POWER HOUSE
FEATHER RIVER POWER COMPANY

Efficiency curve for two 35,000 hp. Pelton Water Wheels in the Bucks Creek Plant.

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Remarkable Performance At Bucks Creek

A study of the accompanying curve shows at once the remarkable performance of the two 35,000 hp. Pelton double overhung impulse wheels in the Bucks Creek plant of the Feather River Power Co. Maximum efficiency of 85.5% was shown by the official test with efficiencies in excess of 85% from 26,400 hp. to 34,200 hp. All of the hydraulic equipment for this plant was designed and built in our San Francisco works.

THE PELTON WATER WHEEL COMPANY

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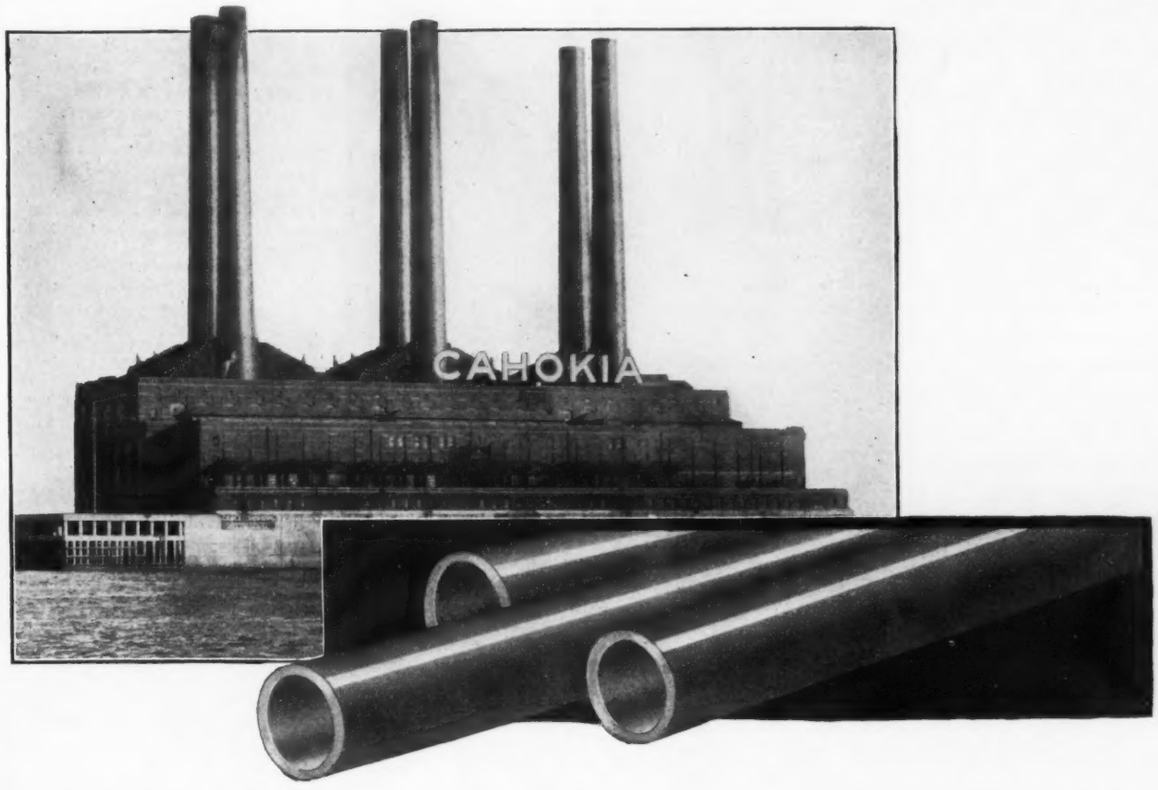

THIS modern, efficient plant, the Cahokia Power Station located near the city of St. Louis, has given Scovill Condenser Tubing a hard service test with the usual result—complete satisfaction. In 1923 one condenser put into operation was equipped with 111,000 pounds of Scovill Cup Drawn Admiralty Condenser Tubes. These tubes have been in use continuously for four years and from every indication will continue to serve, without trouble, for years to come. All this points to the value of manufacturing condenser tubes the Scovill way. The cupping process, for instance, is used in the production of all Scovill Admiralty Condenser Tubing. It is described in detail in a booklet which will be sent on request. For long service life, specify Scovill Cup Drawn Admiralty Condenser Tubing —a product second to none.

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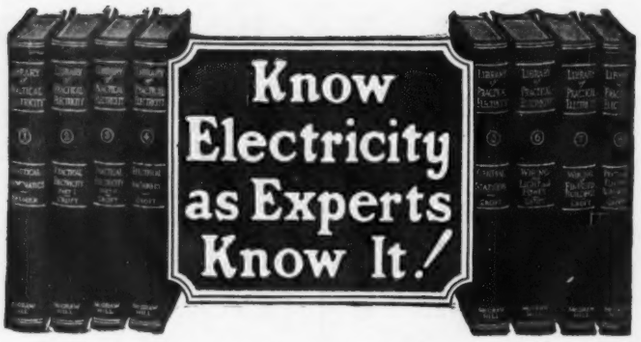

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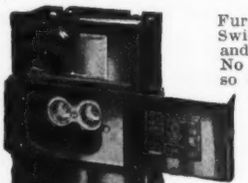
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Send for Bulletin No. 7, listing our entire line of Safety Switches and Panel Boards.

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TANNER ENGINEERING COMPANY INC.
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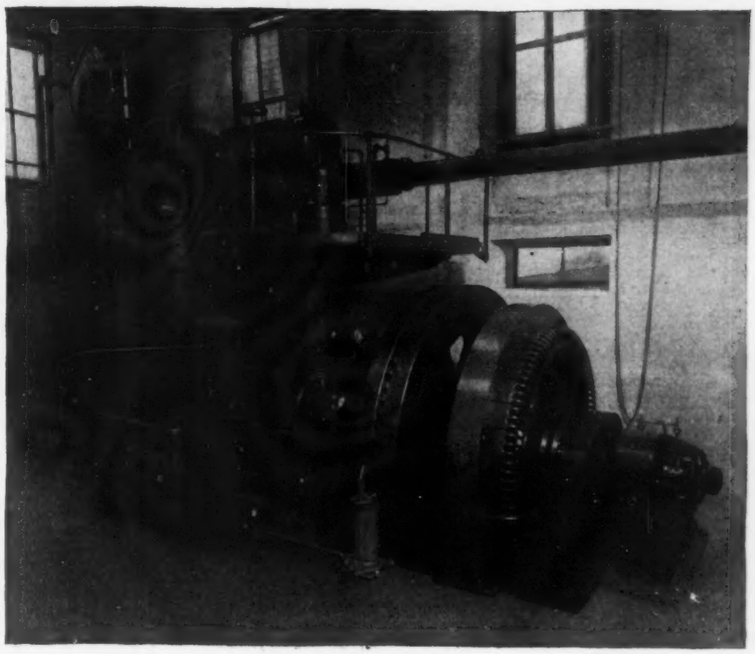
Expanding an overloaded hydro-electric plant—How the problem was solved at Lanesboro, Minn.



A LIGHTING and power plant in Lanesboro, Minn. was formerly able to meet all needs with two 250-kw. generators driven by water wheels, but by 1927 silting of the water storage pond and growth of the community taxed this generating capacity beyond its limits during peak periods. Rebuilding the dam to increase water storage and water wheel capacity would have imposed an enormous increase upon the fixed charges of the plant. It was figured that the cost of fuel for a Diesel engine which would give the desired capacity increase would be much less than the difference between the added fixed costs of the two schemes, and that the Diesel idea was capable of very substantial savings.

The owner therefore purchased a 400-b.hp. McIntosh & Seymour Diesel Engine with direct-connected generator and exciter, and placed this outfit in the existing power house, after slight remodeling and the addition of a two-ton traveling crane. The McIntosh & Seymour Engine is now operated eight to fifteen hours per day over the heavy load period and the water wheels carry the entire load at other times.

This new schedule of operation has proven very satisfactory. Approximately 12 kw-hr. per gal. of fuel are produced by the McIntosh & Seymour outfit at a cost of about ½ ct. per kw-hr., and the plant can still be handled by one man per shift as before. As air-operated jacks position the flywheel for starting, and all water, fuel and lubricating oil are handled automatically, the duties of the attendant are no more arduous than when the water wheels are running.

Diesel engines have several important advantages over other forms of power for use in hydro-electric plants, either to increase peak capacity or for auxiliary use at low water periods. They are always ready for instant starting with no preliminary expense or preparation. There are no standby losses when not in operation. They do not deteriorate while unused as is the case with a steam plant. The fuel required is much more cheaply transported than the fuel for a steam plant would be, because of both the high economy of the engine and the nature of the fuel. Also fuel for a Diesel engine can be stored without loss or deterioration or danger, which is not true of coal. Also because of its high efficiency over a wide load range the Diesel engine produces its power either in parallel with water wheels over the peak periods or running alone during low water periods without penalizing the plant by high fuel costs.

If you operate a hydro-electric plant that is weak during the low-water season or during the busy hours, or if you contemplate developing new hydro-electric facilities where supplementary power would be desirable, our Engineers will show you how to get the fullest practical utilization of the available water power and how to provide the necessary increase at lowest operating and over-all costs, and with absolute dependability.

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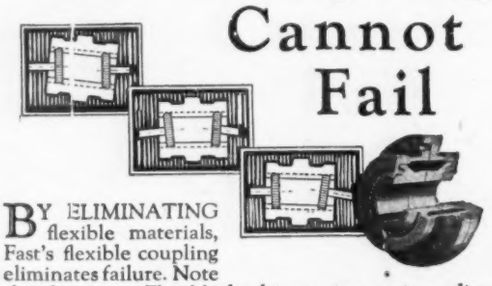
McINTOSH & SEYMOUR DIESEL ENGINES

This Coupling Cannot Fail



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Replacements become a thing of the past, because the coupling will last as long as the connected machines. Nothing to break. Nothing to replace. There is no power loss, and the oil between the gear teeth, under centrifugal pressure, carries the load.

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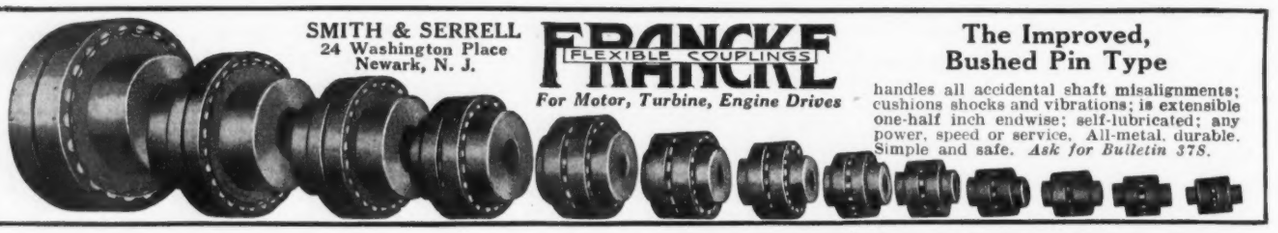
For Motor, Turbine, Engine Drives



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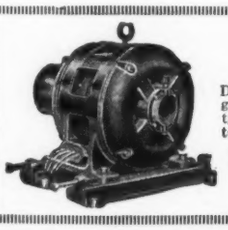

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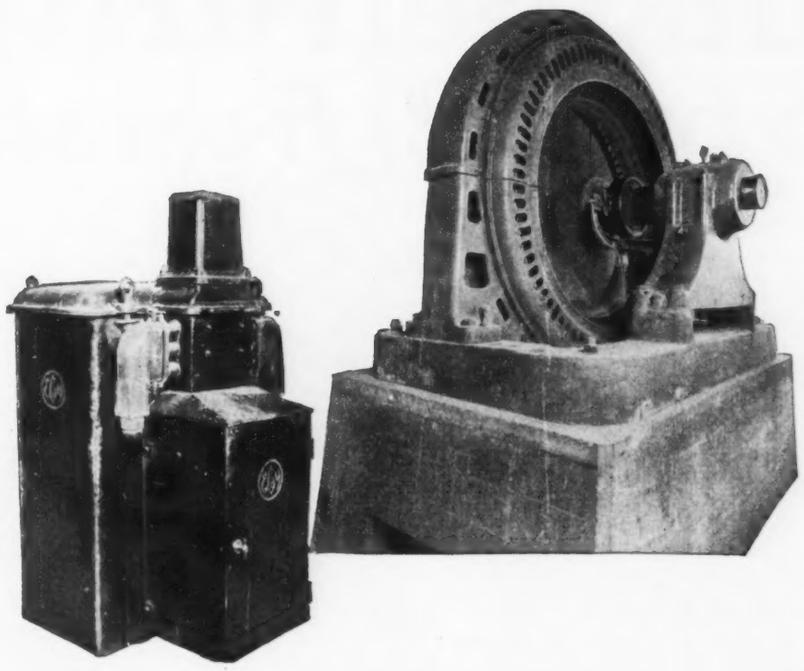

Power bills can be greatly reduced by varying the amount of corrective K.V.A. supplied by a synchronous motor or condenser. Merely set the small contacts on the regulator panel at the desired operating values and the power factor of your entire electrical system will always be maintained between these limits.

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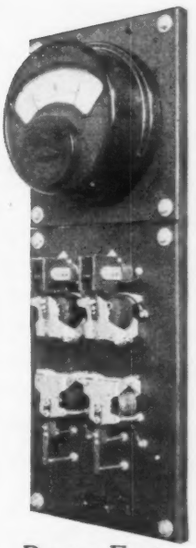
Push button operation provides utmost simplicity so that a skilled operator is not required for this usually complicated job. Positive and accurate overload relays also protect the equipment continuously, regardless of the attention of an operator.

Plan to investigate the advantages of EC&M Synchronous motor control and power factor regulation for the coming year.



Power Factor Regulator Panel

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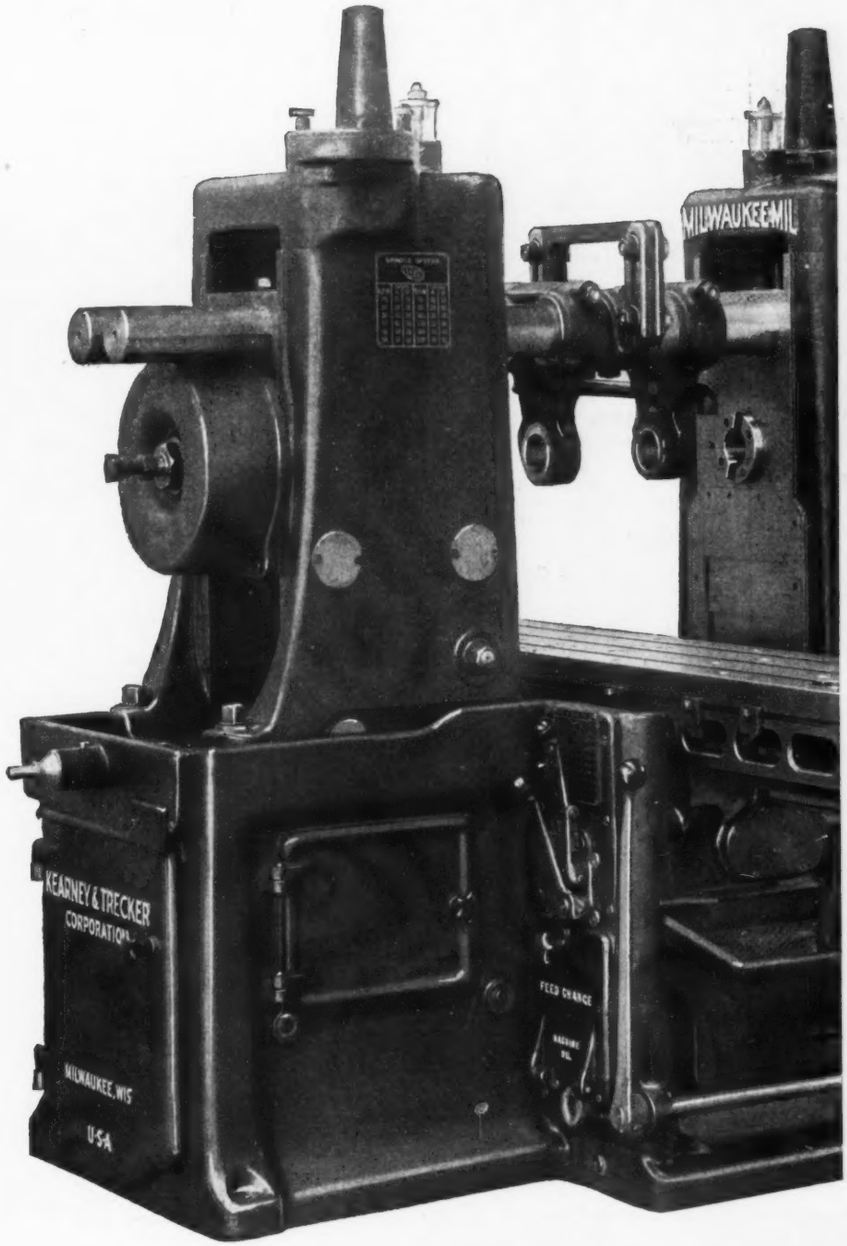

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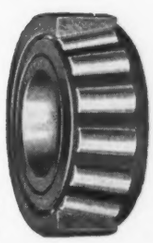

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Equipment, Apparatus and Supplies Advertised in This Issue with Names of Manufacturers

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General Electric Co.
Roller-Smith Co.
Schweitzer & Conrad, Inc.
Sundh Electric Co.
Westinghouse E. & M. Co.
Air
I. T. E. Circuit Breaker Co.
Enclosed Air
I. T. E. Circuit Breaker Co.

Clamps
Cable, Supporting
Matthews Corp., W. N.
Ground Connection
Copperweld Steel Co.
Railway & Industrial Engr. Co.
Sherman Mfg. Co., H. B.
Guy
Hubbard & Co.
Matthews Corp., W. N.
Trolley
Ohio Brass Co.

Cleats
Blake Signal & Mfg. Co.
Imperial Porcelain Co.
Thomas & Sons Co., R.

Clevises
Hubbard & Co.

Clips
Cable
Allis-Chalmers Mfg. Co.
Hubbard & Co.

Clutches, Friction
Link-Belt Co.

Clutches, Magnetic
Cutler-Hammer Mfg. Co.

Coal and Ash Handling Machinery
Link-Belt Co.

Coal Storage Systems
Link-Belt Co.

Coils
Choke
Dudlo Mfg. Co.
Electrical Engineers Equip. Co.
General Electric Co.
Hivoltage Equipment Co.
Ry. & Industrial Eng. Co.
Schweitzer & Conrad, Inc.
Westinghouse E. & M. Co.
Magnet
Dudlo Mfg. Co.
Transformer
Dudlo Mfg. Co.

Compensators
Electric Controller & Mfg. Co.

Compressors, Air
Allis-Chalmers Mfg. Co.

Condensers
Static
Sangamo Electric Co.
Westinghouse Elec. & Mfg. Co.
Steam
Allis-Chalmers Mfg. Co.
General Electric Co.
Westinghouse E. & M. Co.

Condenser Tubes
Scovill Mfg. Co.

Conduits
Clay
National Fireproofing Co.
Underground
National Fireproofing Co.

Conduits, Flexible, Steel, Rigid
General Electric Co.

Conduit, Rigid, Aluminum
Aluminum Co. of America

Connectors and Terminals
Electric Power Equip. Corp.
Electrical Engineers Equip. Co.
General Electric Co.
Hivoltage Equipment Co.
Railway & Industrial Engr. Co.
Sherman Mfg. Co., H. B.
Westinghouse E. & M. Co.

Connectors, Solderless Service
James R. Kearney Corp.

Contact Rail Material
Electric Service Supplies Co.
Ohio Brass Co.
Railway & Ind. Engr. Co.

Contactors
Electric Controller & Mfg. Co.

Control, Electric Valve
Cutler-Hammer Mfg. Co. (Dean)

Control, Railway
Westinghouse Elec. & Mfg. Co.

Control Systems
Electric Controller & Mfg. Co.

Controllers
Automatic
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
Crane
Electric Controller & Mfg. Co.
Motor
General Electric Co.
Industrial Controller Co.
Sundh Electric Co.
Union Electric Mfg. Co.
Westinghouse E. & M. Co.

Converters
Booster
Allis-Chalmers Mfg. Co.
Westinghouse Elec. & Mfg. Co
Synchronous
Westinghouse Elec. & Mfg. Co.

Conveying Machinery
Coal, Ashes, etc.
Link-Belt Co.

Conveyors, Belt
Link-Belt Co.

Coolers, Generator
Sturtevant Co., B. F.

Cord
Flexible
Simplex Wire & Cable Co.
Portable, Rubber Covered
Simplex Wire & Cable Co.

Cords and Cables, Flexible
Okonite Co.
Simplex Wire & Cable Co.

Couplings, Flexible
Bartlett-Hayward Co.
Smith & Serrell

Couplings, Rigid (Shaft)
Smith & Serrell

Crane Motors
General Electric Co.
Westinghouse E. & M. Co.

Cranes, Electrical
Shepard Elec. Crane & Hoist Co.

Cranes, Locomotive
Link-Belt Co.

Cross-Arms
Graybar Electric Co.
Ry. & Industrial Eng. Co.
Thomas & Sons Co., R.
Steel
Bates Steel Corp., Walter

Crushers, Coal and Coke
American Pulverizer Co.
Link-Belt Co.

Cutouts
General Electric Co.
Matthews Corp., W. N.
Westinghouse Elec. & Mfg. Co.
High Tension
Schweitzer & Conrad, Inc.
Plug
James R. Kearney Corp.
Series
G. & W. Elec. Spec. Co.

Devices, Protective
Condit Elec'l. Mfg. Corp.
Electrical Engineers Equip. Co.
Electric Power Equip. Corp
General Electric Co.
Roller-Smith Co.
Ry. & Industrial Eng. Co
Schweitzer & Conrad, Inc.
Westinghouse E. & M. Co.

Doors for Bin and Switch Compartments
Railway & Ind. Engr. Co.

Disconnector
Gang
Hivoltage Equip. Co.
Hook
Hivoltage Equip. Co.

Drills
Earth
Buda Co.
Rock
Hubbard & Co.

Economizers
Babcock & Wilcox Co.
Sturtevant Co., B. F.

Ejectors
Westinghouse Elec. & Mfg. Co.

Electric Railway Materials
Ohio Brass Co.

Electrification Materials, Steam Road
Ohio Brass Co.

Enameling Machinery, Wire
American Insulating Machinery Co.

Engineers and Contractors
Stone & Webster, Inc.

Engineers, Consulting
(See Directory of Engineers)

Engines
Diesel
McIntosh & Seymour Corp.
Gas
Allis-Chalmers Mfg. Co.
Steam
Allis-Chalmers Mfg. Co.
Sturtevant Co., B. F.

Equipment, High Tension
Electrical Engineers Equip. Co.
Line Material Co.
Ohio Brass Co.
Schweitzer & Conrad, Inc.

Equipment, Switching
James R. Kearney Corp.

Equipment, Underground
Line Material Co.

Extinguishers, Fire
American-La France & Foamite Corp.

Fan Motors
Century Electric Co.
General Electric Co.
Westinghouse E. & M. Co.

Fans (Exhaust and Ventilating)
Century Electric Co.
Sturtevant Co., B. F.
Westinghouse E. & M. Co.

Fault Locators
Matthews Corp., W. N.

Fence, Woven Wire
Anchor Post Iron Works
Copperweld Steel Co.

Financial
Electric Bond & Share Co.

Fire Extinguishing Equipment
American-La France & Foamite Corp.

Fittings, Pipe Frame, Electrical
Schweitzer & Conrad Inc.

Flooring, Open Steel
Blaw-Knox Co.

Flooring, Steel
Blaw-Knox Co.

Furnaces, Electric
Detroit Elec. Furnace Co.
Pittsburgh Electric Furnace Corp.
Steel Melting
American Bridge Co.

Fuse Mountings
Railway & Ind. Engr. Co.

Fuses
High Tension
Electrical Engineers Equip. Co.
General Electric Co.
Hivoltage Equip. Co.
Line Material Co.
Matthews Corp., W. N.
Schweitzer & Conrad Co.
Westinghouse Elec. & Mfg. Co.
Renewable
Westinghouse E. & M. Co.
Standard
Condit Elec'l. Mfg. Corp.
General Electric Co.
Graybar Electric Co.
Westinghouse E. & M. Co.

Gage, Draft
Ellison Draft Gage Co.

Galvanizing
Hubbard & Co.

Galvanizing, Hot Dip
Bates Expanded Steel Truss Co.
Cattie & Bros., Jos. P.
Newport News Shipbldg. & Dry Dock Co.

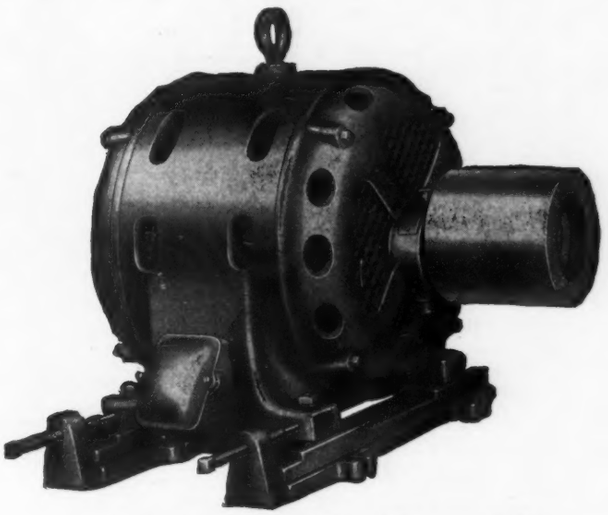
Gates, Head and Sluice
Newport News Shipbldg. & Dry Dock Co.

Gearing, Silent and Flexible
Link-Belt Co.

Gears
Westinghouse Elec. & Mfg. Co.

Generators
Allis-Chalmers Mfg. Co.
Burke Electric Co.
Star Elec. Motor Co.
Sturtevant Co., B. F.
Westinghouse Elec. & Mfg. Co.
Steam
Babcock & Wilcox Co.

Generating Sets
Allis-Chalmers Mfg. Co.
General Electric Co.
Westinghouse E. & M. Co.
Direct Connected & Geared
Westinghouse Elec. & Mfg. Co.
Motor
Allis-Chalmers Mfg. Co.
Turbine Driven
Sturtevant Co., B. F.
Westinghouse Elec. & Mfg. Co.



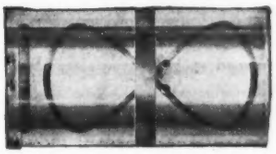
7½ Horse Power Century Type AS Automatic Start Induction 3 and 2 Phase Motor

Automatic or Remote Control

The low starting current of Century Type AS Automatic Start Induction 3 and 2 Phase Motors makes them very desirable for automatic or remote control installations....They develop a starting torque of not less than 225% of full-load torque, with a starting current—within N.E.L.A. rules—never more than 245% of full-load current...These motors will usually start at full load on running fuses....Because of their high power factor, they are desirable for many types of installations on relatively small lines.

Built in standard sizes from 1/2 to 60 horse power. Temperature rating, 40° C.

Bearings are long-lived—they are machined from phosphor bronze castings, the best bearing material obtainable.



CENTURY ELECTRIC COMPANY
1806 Pine St. St. Louis, Mo.
35 Stock Points in the United States and more than 50 outside thereof

Century MOTORS

"THEY KEEP A-RUNNING"

Generating Sets (Cont.)

Governors, Water Wheel
Hydraulic
Pelton Water Wheel Co.
Woodward Governor Co.
Mechanical
Woodward Governor Co.

Grating, Steel
Blaw-Knox Co.
Copperweld Steel Co.
Paragon Electric Co.

Ground Caps
G. & W. Elec. Spec. Co.

Ground Rods
Galvanized
Hubbard & Co.
Copperweld
Copperweld Steel Co.
Hubbard & Co.

Guards, Lamp
Matthews Corp., W. N.

Gauges, Recording
Bristol Company

Hardware, Insulator
Ohio Brass Co.

Hardware, Pole Line
Ohio Brass Co.

Hangers
Ball Bearing
S K F Industries
Cable
Hubbard & Co.

Headlights, Arc and Incandescent
Ohio Brass Co.

Heating Devices
Cutler-Hammer Mfg. Co.
General Electric Co.
Graybar Electric Co.
Westinghouse Elec. & Mfg. Co.

Heaters, Feed Water
Sturtevant Co., B. F.

High Tension Materials
Ohio Brass Co.

High Voltage Porcelain
Cook Porcelain Insulator Corp.

Hoists
Electric and Steam
Allis-Chalmers Mfg. Co.
Link-Belt Co.
Head Gate
Newport News Shipbldg. & Dry Dock Co.

Indicators, Speed (See Tachometers)

Indicators, Transformer Load
Westinghouse Elec. & Mfg. Co.

Inspections and Tests
Electrical Testing Laboratories

Instrument Transformers
General Electric Co.
Weston Elec'l Inst. Co.

Instruments
Boiler Room
General Electric Co.
Westinghouse E. & M. Co.
Electrical
Roller-Smith Co.
Sangamo Electric Co.
Graphic
General Electric Co.
Indicating
General Electric Co.
Roller-Smith Co.
Westinghouse E. & M. Co.
Integrating
General Electric Co.
Sangamo Electric Co.
Westinghouse E. & M. Co.
Portable
Roller-Smith Co.
Westinghouse Elec. & Mfg. Co.
Recording
Landis & Gyr, Ltd.
Westinghouse Elec. & Mfg. Co.
Scientific and Testing, Service
General Electric Co.
Roller-Smith Co.
Sangamo Electric Co.
Westinghouse E. & M. Co.
Weston Elec'l Inst. Co.
Transformer
General Electric Co.
Roller-Smith Co.

Insulating Machinery, Wire
American Ins. Machinery Co.

Insulation Material
Compounds, Paints and Varnishes
Irvington Varnish & Ins. Co.
Westinghouse E. & M. Co.
Comp. Cloth and Paper
General Electric Co.
Irvington Varnish & Ins. Co.
Westinghouse Elec. & Mfg. Co.
Lava
Steward Mfg. Co., D. M.
Westinghouse Elec. & Mfg. Co.
Mica, Micarta
Westinghouse Elec. & Mfg. Co.
Molded
Cutler-Hammer Mfg. Co.
Garfield Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Paper
Irvington Varnish & Ins. Co.
Porcelain
Ohio Brass Co.
Thomas & Sons Co., R
Silk
Irvington Varnish & Ins. Co.
Slate
Portland Monson Slate Co.
Tape and Webbing
General Electric Co.
Okonite Co., The
Westinghouse Elec. & Mfg. Co.
Treated Fabrics & Paper
Westinghouse Elec. & Mfg. Co.
Untreated Fabrics & Paper
Westinghouse Elec. & Mfg. Co.

Insulation
Electrical
Bakelite Corp.
Thomas & Sons Co., R
Westinghouse Elec. & Mfg. Co.
Molded
Bakelite Corp.

Insulators
High Voltage Porcelain
Electric Service Supplies Co.
Franklin Porcelain Co.
Lapp Insulator Co., Inc.
Ohio Brass Co.
Porcelain Ins. Corp.
Thomas & Sons Co., R.
Glass
Lapp Insulator Co., Inc.
Pin Type
Cook Porcelain Insulator Corp.
Porcelain Ins. Corp.
Railway & Industrial Engr. Co.
Thomas & Sons Co., R.
Porcelain
Canadian Porcelain Co., Ltd.
Cook Porcelain Ins. Corp.
Ohio Brass Co.
Porcelain Ins. Corp.
Thomas & Sons Co., R.
Porcelain, Composition
General Electric Co.
Imperial Porcelain Works
Jeffery Dewitt Ins. Co.
Lapp Insulator Co., Inc.
Ohio Brass Co.
Porcelain Ins. Corp.
Thomas & Sons Co., R.
Porcelain and Composition
Westinghouse Elec. & Mfg. Co.

Insulator Pins
Cook Porcelain Insulator Corp.
Ohio Brass Co.
Thomas & Sons Co., R.

Insulator, Pin Type
Cook Porcelain Ins. Corp.
National Lamp Works
Ohio Brass Co.
Thomas & Sons Co., R

Irons, Electric
Westinghouse E. & M. Co.

Laboratories
Electrical Testing Laboratories

Lamps
Arc
General Electric Co.
Westinghouse E. & M. Co.
Cable Supporting
Matthews Corp., W. N.
Incandescent
General Electric Co.
Graybar Electric Co.
Westinghouse Elec. & Mfg. Co.
Miniature Inc.
General Electric Co.

Lighting Equipment, Interior and Exterior
Hubbard & Co.
Westinghouse Elec. & Mfg. Co.

Lighting Fixtures, Outdoor
Line Material Co.

Lighting Standards
Bates Steel Corp., Walter

Lightning Arresters
Electric Power Equip. Corp.
Electric Service Supplies Co.
Electrical Engineers' Equip. Co.
General Electric Co.
Hivoltage Equipment Co.
Hubbard & Co.
Ry. & Industrial Eng. Co.
Schweitzer & Conrad, Inc.
Westinghouse E. & M. Co.

Line Material
Cook Porcelain Insulator Corp.
Electric Service Supplies Co.
General Electric Co.
Hubbard & Co.
Line Material Co.
Ohio Brass Co.
Westinghouse E. & M. Co.

Lineman's Safety Platform
Hubbard & Co.

Locomotives
Electric
Westinghouse Elec. & Mfg. Co.

Lugs
Sherman Mfg. Co., H. B.

Machinery
Armature Repair
Electric Service Supplies Co.
Mining
Allis-Chalmers Mfg. Co.

Machines, Welding
Westinghouse Elec. & Mfg. Co.

Magnets
Cutler-Hammer **Mfg. Co.**

Magnets, Lifting
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.

Meter Testers
General Electric Co.
Westinghouse E. & M. Co.

Meters
Demand
Landis & Gyr, Ltd.
Sangamo Electric Co.
Westinghouse Elec. & Mfg. Co.
Indicating
Westinghouse Elec. & Mfg. Co.
Kilovolt Amperes
Landis & Gyr, Ltd.
Sangamo Electric Co.
Westinghouse Elec. & Mfg. Co.
Recording
Tanner Eng. Co.
Westinghouse Elec. & Mfg. Co.
Remote Indicating
Tanner Eng. Co.
Watthour
Landis & Gyr, Ltd.
Sangamo Electric Co.
Westinghouse Elec. & Mfg. Co.

Meters, Flow (See Instruments, Electric and Boiler Room)

Molded Insulation (See Insulation, Molded)

Molded Parts
Garfield Mfg. Co.

Molding Materials
Bakelite Corp.

Motors
Allis-Chalmers Mfg. Co.
Baldor Electric Co.
Burke Elec. Co.
Century Electric Co.
General Electric Co.
Graybar Electric Co.
Lincoln Electric Co.
Marble-Card Elec. Co.
Star Elec. Motor Co.
Sturtevant Co., B. F.
Westinghouse Elec. & Mfg Co.
Fan
Graybar Electric Co.
Mine
Westinghouse Elec. & Mfg Co.
Railway
Westinghouse Elec. & Mfg Co.
Small
Westinghouse E. & M. Co.

Motor Generator Sets
Burke Elec. Co.
Star Elec. Motor Co.

Oil Burners
Babcock & Wilcox Co.

Oil Engines (See Engines)

Overhead Line Materials
Copperweld Steel Co.
Ohio Brass Co.

Painting Equip. Mech. or Elec'l.
Matthews Corp., W. N.

Paints, Aluminum
Aluminum Co. of America

Panel Boards
General Electric Co.
Trumbull Elec. Mfg. Co.

Panels, Switchboard
Allis-Chalmers Mfg. Co.
General Electric Co.

Penstocks
Newport News Shipbldg. & Dry Dock Co.

Pins, Insulator
Hubbard & Co.
Ohio Brass Co.

Pipe
Riveted Steel
Newport News Shipbldg. & Dry Dock Co.
Riter-Conley Mfg. Co.

Pipe Frame Fittings, Elec'l
Electrical Engineers Equip. Co.
Schweitzer & Conrad, Inc.
Westinghouse Elec. & Mfg Co.

Plugs
Attachment and Cap
General Electric Co.
Westinghouse E. & M. Co.
Attachment
Cutler-Hammer Mfg. Co.
General Electric Co.

Pole Line Hardware
Electric Service Supplies Co.
Graybar Electric Co.
Hubbard & Co.
Ohio Brass Co.
Thomas & Sons Co., R.
Westinghouse Elec. & Mfg Co.

Poles
Cedar
Bell Lumber and Pole Co.
Creosoted Southern Pine
Graybar Electric Co.
Iron
Archbold-Brady Co.
Steel
Aermotor Co.
Archbold-Brady Co.
Bates Expanded Steel Truss Co.
Bates Steel Corp., Walter
Riter-Conley Mfg. Co.

Poles, Reinforcing of
Hubbard & Co.

Potentiometers
General Electric Co.
Westinghouse Elec. & Mfg Co.

Potheads
Electrical Engineers Equip. Co.
G. & W. Elec. Spec. Co.
Ohio Brass Co.
Railway & Industrial Engr. Co.

Preheaters, Air
Blaw-Knox Co.
Sturtevant Co., B. F.

Projectors, Floodlighting
Electric Service Supplies Co.
Westinghouse Elec. & Mfg Co.

Pullers, Slack
Matthews Corp., W. N.

Pulverized Fuel Equipment
American Pulverizer Co.

Pumps
Pelton Water Wheel Co.
Centrifugal
Allis-Chalmers Mfg. Co.
Reciprocating
Allis-Chalmers Mfg. Co.

Racks, Cable
G. & W. Elec. Spec. Co.

Racks, Intake
Newport News Shipbldg. & Dry Dock Co.

Racks, Secondary
Hubbard Co.

Radio Apparatus
Cutler-Hammer Mfg. Co.
General Electric Co.
Westinghouse E. & M. Co.

Rail Bonds
American Steel & Wire Co.
Copperweld Steel Co.
Ohio Brass Co.

Rake, Rack
Newport News Shipbldg. & Dry Dock Co.

Ranges, Electric
Westinghouse Elec. & Mfg Co.

Rectifiers
General Electric Co.
Westinghouse E. & M. Co.

Reels, Take-Up and Pay-Out
Matthews Corp., W. N.

Refrigerators
General Electric Co.

Regulators, Feedervoltage
Westinghouse Elec. & Mfg Co.

Relays
Condit Elec'l Mfg. Corp.
Electric Controller & Mfg. Co.
Roller-Smith Co.
Westinghouse Elec. & Mfg Co.

Repairing (See Searchlight Section)

Replacers, Lamp
Matthews Corp., W. N.

Resistance Units
Cutler-Hammer Mfg. Co.
General Electric Co.
Ry. & Industrial Eng. Co.

Resistors
Electric Controller & Mfg. Co.
Schweitzer Conrad, Inc.
Westinghouse Elec. & Mfg. Co.

Rheostats
Cutler-Hammer Mfg. Co.
General Electric Co.
Sundh Electric Co.

Rings, Cable
Copperweld Steel Co.
Hubbard & Co.

Screws, Lag
Hubbard & Co.

Searchlights
General Electric Co.

Second-Hand Apparatus (See Searchlight Section)
Archer & Baldwin, Inc.
Belyea Co., Inc.
Consolidated Products Co.
Electric Service Co., Inc., (Cinn., O.)
Hall & Co., Inc., Stephen
Hemphill & Co., J. L.
Land, L. J.
Nussbaum Co., V. M.
Perry Buxton Doane Co.
Randle Machinery Co.
Ross Power Equip. Co.
Sachsenmaier Co., George
Stewart Co., Paul
United Commercial Co., Inc.

Separators, Magnetic
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.

Slate
Portland Monson Slate Co.

Sockets and Receptacles
Cutler-Hammer Mfg. Co.
General Electric Co

Solders
Westinghouse Elec. & Mfg. Co.

Soldering Flux
Westinghouse Elec. & Mfg. Co.

Soldering Irons
Cutler-Hammer Mfg. Co.

Solenoids (See Coils)

Staples
Copperweld Steel Co.
Hubbard & Co.

Staples, Insulated
Blake Signal & Mfg. Co.
Superior Mfg. Co.

Starters, Motor, Electric
Condit Elec'l Mfg. Corp.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
General Electric Co.
Industrial Controller Co.
Sundh Electric Co.
Westinghouse E. & M. Co.

Steel
Alloy
Timken Roller Bearing Co.
Electric Furnace
Timken Roller Bearing Co.
Open Hearth
Timken Roller Bearing Co.
Special Analysis
Timken Roller Bearing Co.

Steel, Electrical Sheets
Empire Steel Corp.

Steel Fabrication
Bates Steel Corp., Walter

Steel Plate Work
Blaw-Knox Co.
Newport News Shipbldg. & Dry Dock Co.

Stokers
Babcock & Wilcox Co.
General Electric Co.
Mechanical
Westinghouse E. & M. Co.

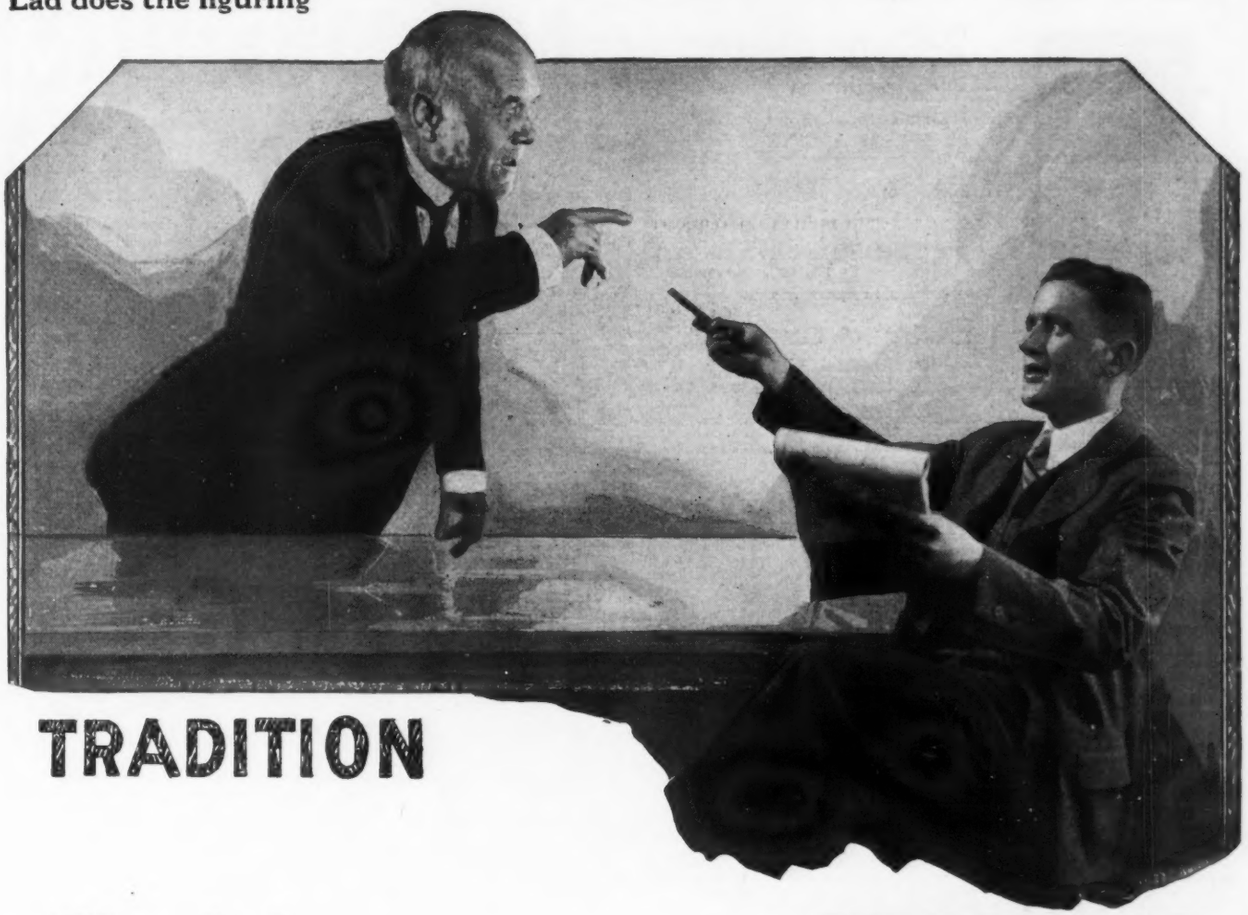
Stoves, Electric (See Ranges, Etc.)

Structural Steel
Bates Steel Corp., Walter

Structures, Steel
American Bridge Co.
Blaw-Knox Co.

Sub-Stations
Automatic and Electro Pneumatic Automatic
Westinghouse Elec. & Mfg Co.
Complete Manual
Westinghouse Elec. & Mfg. Co
Outdoor
Aermotor Co.
Electric Power Equip. Corp.
Electrical Engineers Equip. Co.
General Electric Co.
Hivoltage Equipment Co.
Ry. & Industrial Eng. Co.
Schweitzer & Conrad, Inc.
Westinghouse E. & M. Co.

Lad does the figuring



TRADITION

"Here, Lad—

what I can't figure out is why a company the size of Lincoln Electric should be the leader in arc welding instead of the much larger companies.
Is there a reason?

PROGRESS

"No, Pop—

there are four reasons.
And number one is that Lincoln was FIRST in the field with a commercial arc welder.
Next, their patents enable them to give their machine a wider welding range than any other welder.
Then they have specialized on arc welding and have not branched into various departments of electricity.
And a big factor in their development is in the burning up of red tape in dealing with customers. No matter what's your problem, you get the right answer —promptly.
So that's why they're at the head of the class.
You know how the kid feels when he's kept after school because his father, who has other interests, figured his arithmetic wrong?"

Only "Stable-Arc" Welders have all these features

- Variable Voltage.
- Laminated Magnetic Circuit.
- Separately-excited Generator Field.
- Double Control of Welding Heat.
- Steady Arc Throughout Entire Welding Range.
- All Steel Construction.
- Full Capacity for either Metallic or Carbon Arc Welding.

These features make welding easier. Results—better welds and greater output.

Ask any Operator!

The Lincoln Electric Co., Dept. No. 1-12, Cleveland, O.

W-67

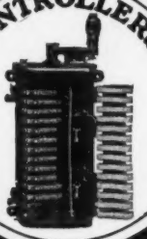
LINCOLN "Stable-Arc" WELDER

2-Rate Meter
with maximum demand indicator. Type FBodm

Information on Landis & Gyr 2-rate or 3-rate meters on request. (Type CBot is the 3-rate meter.)

LANDIS & GYR, INC.
104 Fifth Ave., New York
HERBERT NEHLS, V. P. and Gen. Mgr.
10

UNION DRUM
Electric Motor Control Apparatus
ALL TYPES OF D.C. MOTORS
SLIP RING SQUIRREL CAGE MULTI-SPEED A.C. MOTORS
CONTROLLERS



Union Electric Mfg. Co.
Milwaukee, Wis.
Offices in all Principal Cities
Standard-Special Explosion Proof For all Purposes A.C-D.C.
CRANES HOISTS TRUCKS TRACTORS METAL AND WOOD MACHINERY ... SPECIAL AND INDEPENDENT APPLICATION

it's Automatic When You Think of Motor Control Say I-C
A COMPLETE LINE OF AUTOMATIC STARTERS FOR THE INDUSTRIAL PLANT
(Write for Catalog)
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Milwaukee, Wisconsin

THE MOST COMPLETE LINE OF BALL BEARINGS TYPES AND SIZES IN AMERICA
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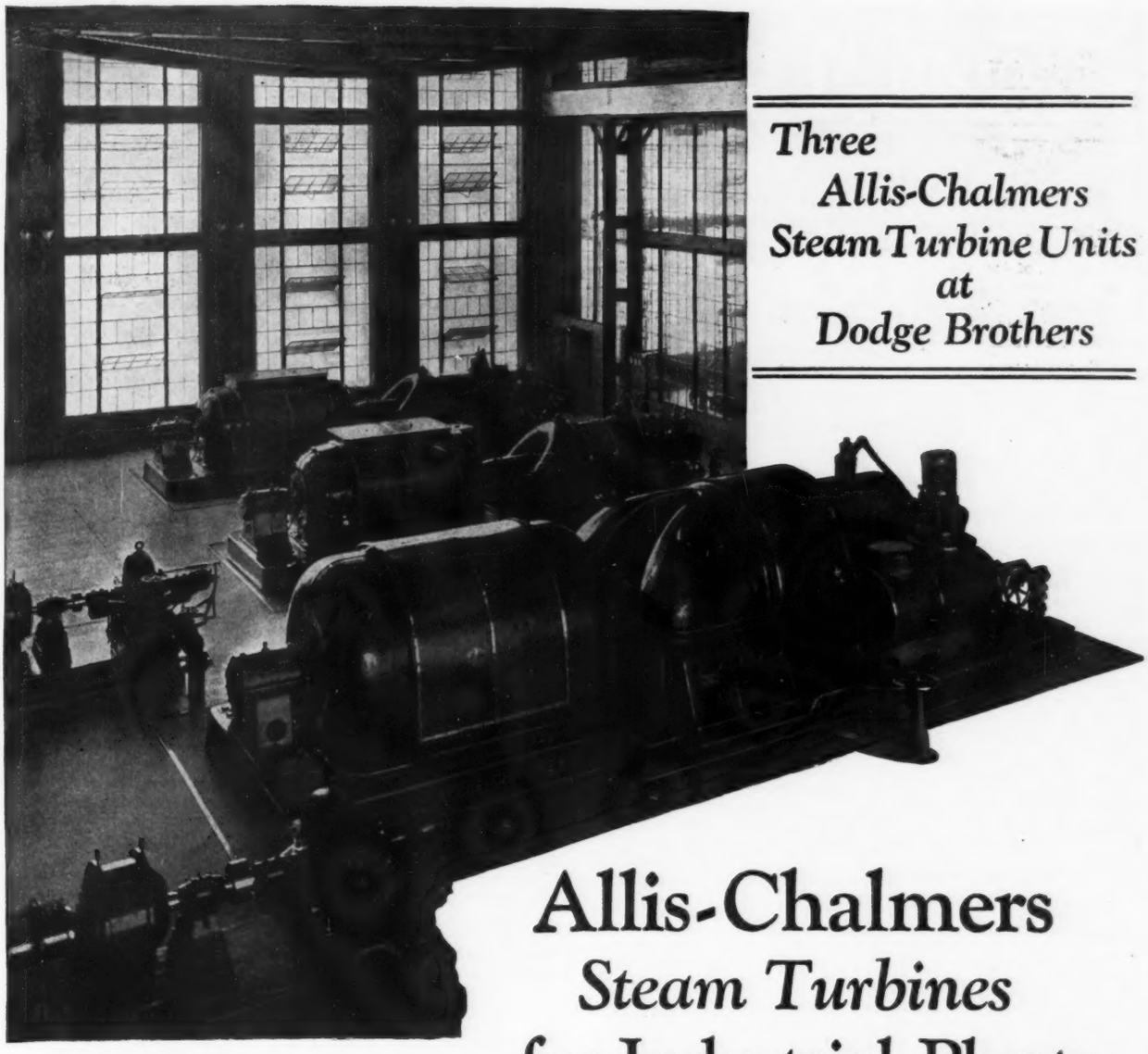

Three Allis-Chalmers Steam Turbine Units at Dodge Brothers

Allis-Chalmers *Steam Turbines* —for Industrial Plants

Reliability is the primary requisite in power generating equipment in industry.

Allis-Chalmers Steam Turbine Units are KNOWN for reliability and efficiency.

The 10,000 K. W. Steam Turbine generator in the foreground is the fourth Allis-Chalmers unit installed in the Dodge Brothers power plant at Detroit.

A 750 K. W. unit (not shown) was installed in 1913—the two 4000 K. W. units in 1921 and the 10,000 K. W. in 1924. These repeat orders attest the satisfactory performance of A. C. Steam Turbines in actual operation.

ALLIS-CHALMERS MANUFACTURING CO.
MILWAUKEE, WIS. U.S.A.

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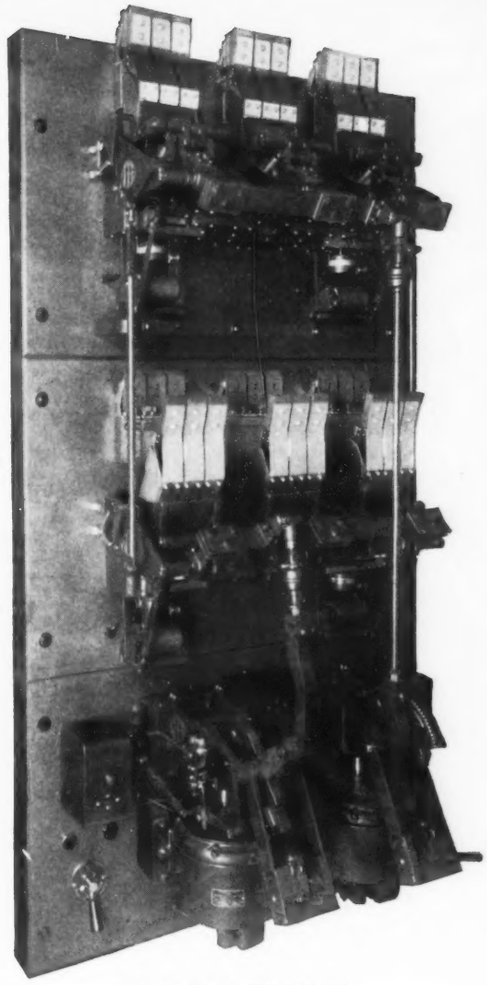
Another Protection Problem
Solved by I·T·E·



I-T-E FULL AUTOMATIC
TRANSFER SWITCH

the problem

In a large office building having a combined power and lighting load of 15,000 amperes: —

1. To insure uninterrupted service by automatic switching of the load from one source to another.
2. To provide overload and short circuit protection for the system.

the solution

The use of two I-T-E full Automatic Transfer Switches, each consisting of 2 — 7500 ampere, 3-pole circuit breakers with direct acting series overload and short circuit trip coils, mechanically and electrically interlocked to give these functions: —

1. Failure of normal circuit automatically trips the normal circuit breaker and closes the emergency circuit breaker.
2. Return of normal circuit automatically trips the emergency circuit breaker and closes the normal circuit breaker.
3. If either circuit breaker opens on overload or short circuit both circuit breakers remain open until proper one is closed by control switch. This prevents transfer of overload or short circuit from one source to the other.

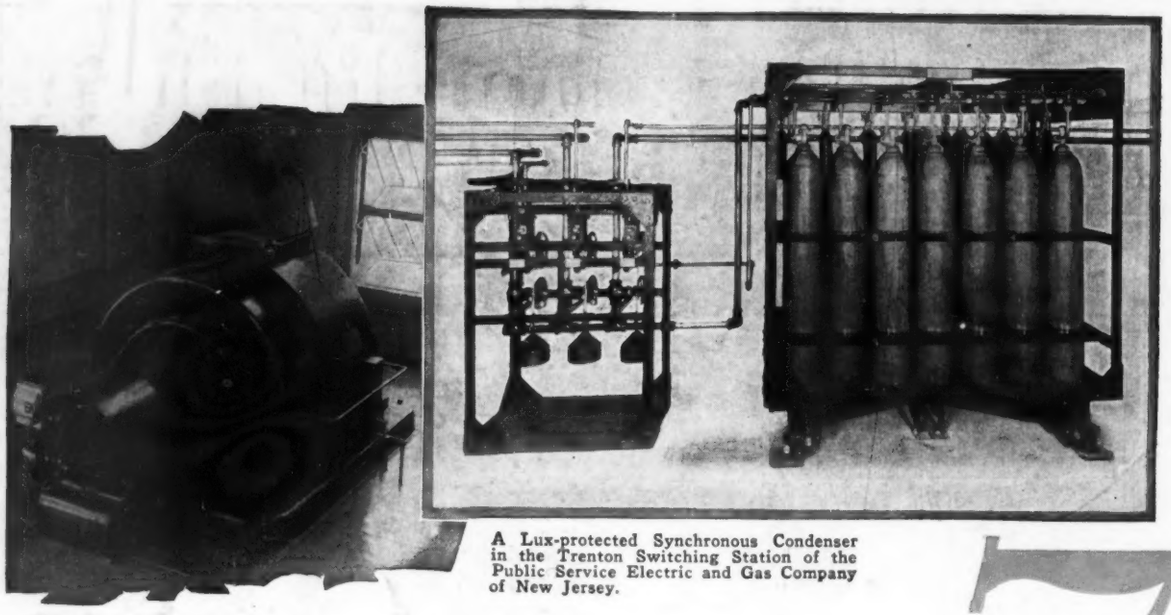
Whether your protection problems are simple or difficult, I-T-E circuit breakers will solve them correctly and dependably.

The assured performance of I-T-E is based upon the experience of forty years in specializing on the design and manufacture of circuit breakers.

I-T-E CIRCUIT BREAKER COMPANY—19th and Hamilton Streets, Philadelphia

Birmingham, American-Traders Bank Bldg.; **Boston**, 201 Devonshire; **Buffalo**, Ellicott Sq. Bldg.; **Chicago**, 333 N. Michigan Ave.; **Cincinnati**, Union Trust Bldg.; **Cleveland**, 1740 E. 12th; **Dallas**, 1410 Allen Bldg.; **Denver**, Tramway Bldg.; **Detroit**, Penobscot Bldg.; **Duluth**, 611 Providence Bldg.; **Kansas City**, Midland Bldg.; **Los Angeles**, 106 W 3rd; **Minneapolis** Plymouth Bldg.; **Montreal**, P. Q., 35 Notre Dame St., West; **New Orleans**, Hibernia Bank Bldg.; **New York**, 12 E. 41st.; **Omaha**, Electric Bldg.; **Philadelphia**, 1505 Race; **Pittsburgh**, Park Bldg.; **St. Louis**, Bank of Commerce Bldg.; **San Francisco**, Russ Bldg.; **Seattle**, 2518 Western; **Toronto**, 24 Adelaide, E.; **Vancouver**, 500 Beatty St.; **Tulsa, Oklahoma**, Box 1141.

I-T-E PROTECTION
URELITES ~ ~ I-T-E CIRCUIT BREAKERS



A Lux-protected Synchronous Condenser in the Trenton Switching Station of the Public Service Electric and Gas Company of New Jersey.

Protection for Service Against Fire Interruptions

7

What happens to service when fire occurs in a power plant? How long does it take to dry out windings—to clean up equipment—to get machines back on the line again?

A week or more if water or chemicals are used for extinguishing because of the mess they leave.

But if the Lux System is used, service is resumed after only a brief interruption for repairs to the insulation at the point of rupture. Lux leaves all equipment after fire, just as dry and clean as it was before.

The Lux extinguishing agent, an inert gas, is harmless and bone dry. It leaves no residue. After ventilation it dissipates in the air.

That is one reason why the Lux System eliminates long operating interruptions. And why the Lux System is used for fire protection in power plants in the United States, England, Germany, Italy, Japan and other countries.

POINTS OF LUX SUPERIORITY

1. Penetrates and extinguishes in three dimensions.
2. Dry, clean, leaves no residue; non-conductor.
3. Non-freezing—good until used.
4. Built-in efficiency—requires no skill to operate.
5. Proved effective in service on over 100 fires.
6. Listed by Underwriters' Laboratories
7. Backed by 10 years' specialization in nothing but inert gas fire extinguishing.

Engineers will find an interesting discussion of Lux protection for electrical equipment in the booklet, "Snuffing Out Fire in Power Plants." A copy will be sent upon request.

LUX

TRADE MARK

Walter Kidde & Company, Inc.
140 Cedar Street
New York

THE EXTINGUISHER THAT DOES NO DAMAGE

Walter Kidde & Company, Inc.
140 Cedar St., New York, N. Y.

Kindly mail me, without obligation, a copy of your booklet, "Snuffing Out Fire in Power Plants."

Name .....

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